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### **A SURVEY OF THE Rh PROBLEM IN TORONTO, 1947-1952\*†**

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**I**N 1946 a committee was formed with representatives of the laboratory and obstetrical services of the various teaching hospitals and the Department of Paediatrics of the University of Toronto to devise practical ways and means of dealing with the problems of Rh isoimmunization and erythroblastosis.

With funds made available from the Banting Research Foundation, it was decided to set up a central Rh laboratory in The Hospital for Sick Children. It was considered advisable to locate this laboratory in the latter institution because the adult teaching hospitals had no pediatric services and all infants requiring treatment would be sent to The Hospital for Sick Children.

The plan evolved was that all women who obtained prenatal care, whether clinic or private patients, would have, in addition to other tests, a routine determination as to whether they were Rh positive or negative to D. This testing was to be done in the laboratories of the various adult hospitals by means of the Diamond slide test.<sup>1</sup> Blood from all negative women and from any other women with suggestive obstetrical histories was to be sent to the Rh laboratory of The Hospital for Sick Children for confirmation of their Rh type and to be tested for the presence of antibodies. If antibodies were detected, a titer was established. In the Rh laboratory the usual battery of tests was performed as indicated and as they became available. These included

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repetition of the slide test, water bath test tube tests in both saline and 20 per cent bovine albumin, Coombs tests, and the use of trypsinized red cells. Although suitable panels of test cells were selected to cover all the various Rh subtypes, except in unusual cases, in the routine testing no attempt was made to identify or measure Anti-C and Anti-E components which might be associated with Anti-D.

Within a few months after the Rh laboratory was in operation, the scope of the organization was broadened to include all the Toronto hospitals. In addition, as the existence of the laboratory became generally known, numerous blood specimens were sent for testing from private doctors and hospitals throughout various parts of Ontario.

By the end of 1952, as the organization had been in operation for a little over six years, it was decided to review the data which had accumulated during the period from January, 1947, to December, 1952. Since a large proportion of the infants born to the women whose sensitization was detected in the Rh laboratory were treated in The Hospital for Sick Children, it was considered that useful information as to the extent and status of the Rh problem including erythroblastosis in the Toronto area could be obtained.

#### **Incidence of Rh Isoimmunization**

An accurate incidence of the natural pregnancy-induced isoimmunization to one or more of the Rh factors is difficult to determine. To obtain accurate statistical data it would be necessary to follow in detail a large group of women, particularly those negative to D, throughout their entire childbearing period, testing them in each pregnancy, and having accurate information as to whether their husbands were homozygous or heterozygous and eliminating all cases in which the sensitization was transfusion induced. A figure frequently quoted, taking into consideration all pregnancies, is that approximately 5 per cent of the Rh-negative women married to Rh-positive husbands will have one or more erythroblastotic infants.<sup>2, 3</sup>

In the Rh laboratory of The Hospital for Sick Children during the six-year period from January, 1947, to December, 1952, 11,886 women negative to D were tested for the presence of antibodies. Antibodies were present in 749, an incidence of 6.4 per cent. If 88 women who were sensitized by transfusion are eliminated, the incidence would be 663 in 11,783 or 5.6 per cent (Table I). However, this figure (5.6 per cent) may be weighted by the reference of blood specimens from women with suggestive clinical histories. On the other hand, some of the women found to be Rh negative are married to Rh-negative husbands. It is doubtful if the women tested by the laboratory constitute an unselected series of Rh-negative childbearing women.

In addition to the above, 5 Rh (D) positive women were sensitized to E and/or c (Table I). All of these had infants suffering from erythroblastosis. Two of these were sensitized by pregnancy, the remaining 3 by transfusion. With the exception of ABO incompatibility, no other type of blood incompatibility except the Rh system was found to be responsible for erythroblastosis.



TABLE I. RH LABORATORY, THE HOSPITAL FOR SICK CHILDREN  
Period January, 1947-December, 1952

Total number of Rh (D) negative women tested	11,886	
Total number sensitized primarily to D	747	6.4%
Isoimmunized by transfusion	88	
Isoimmunized by pregnancy	659	5.6%
Rh (D) positive women sensitized to Rh factors other than D	5	
Isoimmunized by transfusion	3	
Isoimmunized by pregnancy	2	

In attempting to appraise the possibility as to whether or not an Rh-negative woman married to an Rh-positive husband will develop antibodies, many factors will have to be taken into consideration. Many of these factors are as yet hypothetical and their effects cannot be measured.

It is almost universally assumed that for sensitization to take place, some fetal cells must gain access to the maternal circulation. If this is the case, is it thus necessary to postulate some pathological defect in the placenta or can it be presumed that it is physiological for at least a few fetal cells to leak across the placenta? If the leakage is to be considered as a pathological process, one would expect that the age of the mother, geographical environment, economic status, and other factors would alter the incidence of isoimmunization and the disease erythroblastosis. A large number of data have been collected from a number of centers which have proved to be remarkably uniform. All state that approximately 5 to 6 per cent of Rh-negative women married to Rh-positive husbands will become sensitized. No reliable statistics have been adduced that this incidence of sensitization is in any way affected except by the number of Rh-negative individuals in the population.

One can almost assume that in every pregnancy some fetal cells enter the maternal circulation either during the period of fetal growth or at the time of the separation of the placenta. Thus, theoretically, isoimmunization could occur in every pregnancy provided the relationship between the potency of the antigen, duration of stimulus, and reactivity of the maternal tissues was optimum.

Experience has shown that there is a wide variation in the antigenic potency of the various Rh factors ranging from D, the most potent, to d, the least potent. The recently described F and f factors are possibly of a still lower order of potency.<sup>4</sup> There is also a great likelihood that various D's differ in their ability to stimulate antibody formation.

Variation in the capacity of the mother to form antibodies is also a real but not readily assessable factor. It has been demonstrated under experimental conditions that only about 50 per cent of Rh-negative male volunteers could be isoimmunized by transfusion or injection of positive blood. Hence it may be assumed that even if all Rh-negative mothers were exposed to a D antigen of equal potency there would be great variation in their antibody response.

There is also the question of duration of stimulus. If a woman with only a slight susceptibility to sensitization becomes pregnant often enough she

will eventually become isoimmunized. We have in our records one case where the fifteenth pregnancy resulted in an erythroblastotic infant that survived. There were 11 normal living children. The results of three early pregnancies were unknown.

### The Prognosis for Sensitized Mothers

Once sensitization of a mother has been established, the results of future pregnancies can almost always be correctly predicted, provided that the husband is homozygous. As a general rule, the infant will be more severely affected in each subsequent pregnancy. Of course, if the husband is heterozygous, one can state that there is a 50 per cent chance in any pregnancy that the mother will deliver an Rh-negative infant normal in regard to the Rh factors. However, even if the husband is homozygous and an infant has been born with erythroblastosis that was severe enough to cause death, occasionally a subsequent infant with an apparently milder form of erythroblastosis may survive and be perfectly normal (Table II). We have seen one case where the subsequent child, although Rh positive, was clinically and to all laboratory tests a normal infant. Even when the mother has been isoimmunized by transfusion, a normal surviving Rh-positive child may be obtained subsequent to a fatality. Some of these cases may be attributed to earlier and better treatment of the second involved infant but in other cases the succeeding infant definitely had a milder disease. Hence, although the prognosis, particularly if the husband is homozygous, is grave, it need not necessarily be hopeless.

TABLE II. ERYTHROBLASTOSIS FETALIS. PROGNOSIS IN SUBSEQUENT PREGNANCIES

Of 661 mothers isoimmunized by pregnancy 33 had 40 surviving normal erythroblastotic infants subsequent to one that died.
Of 83 mothers isoimmunized by transfusion 3 had 4 surviving normal erythroblastotic infants subsequent to one that died.*

\*Does not include the 8 sensitized mothers married to Rh-negative husbands.

### Mothers Isoimmunized by Transfusion

A mother was judged to have been isoimmunized by transfusion by the date of the transfusion and its relationship to the occurrence of an erythroblastotic infant in her obstetrical history. It is clear that, before Rh testing became available, the chances of an Rh-negative patient's receiving Rh-positive blood were 85 per cent. In most cases it was obvious that sensitization had been induced by one or more transfusions. With modern transfusion and blood-bank techniques, this type of isoimmunization should be reduced to a minimum. In the Toronto area a notable reduction has already occurred, although there is still apparently a backlog of Rh-negative women who have been sensitized by transfusion. In 1947, of all Rh-sensitized women 15 per cent had been sensitized by transfusion; by 1952 this had been reduced to 6 per cent.

As will be discussed later, sensitization induced by transfusion is apparently more intense and results in a more severe type of disease in the infant. Most of the cases of erythroblastosis occurring in the first-born are the result of previous transfusions with incompatible blood.

Modern transfusion and blood-bank techniques should eliminate sensitization of an Rh (D) negative individual to the D factor at least. To offer complete protection against the less antigenic C, E, c, and e factors in the routine hospital blood bank is hardly practical at the present time but the hazards in this respect are minimal although the occasional Rh (D) positive woman will be sensitized. It should be emphasized, however, that one precaution can be taken to protect women against possible isoimmunization with one of the rare blood types, e.g., no woman should receive a transfusion from her husband no matter how compatible their bloods may seem.

A rather interesting observation (see Table III) is the relatively small number of women who gave a history of having received a transfusion as a child. During the decade from 1921 to 1930, in Toronto at least, transfusions became an extremely popular form of therapy. In adults it is assumed that 50 per cent of Rh-negative individuals may be permanently sensitized by the exhibition of Rh-positive blood. If the same applies to Rh-negative girls in infancy and childhood, it is rather surprising that no more than approximately 2.5 per cent of the total number exposed to the risk are now known to be sensitized on reaching the childbearing age. It is unlikely that shifts in populations would account for any appreciable diminution of the number of individuals transfused as children. It would appear that possibly infants and children are not as easily sensitized by a transfusion as adults and that perhaps we had not done as much damage as we had anticipated.

TABLE III. MOTHERS ISOIMMUNIZED BY TRANSFUSION. TOTAL NUMBER 91\*

Rh (D) negative married to Rh (D) negative husbands	8
Isoimmunized as children (under 14 years)	10
On the basis of 6,271 transfusions given in The Hospital for Sick Children during the years 1921 to 1930, inclusive, it is estimated that approximately 400 female Rh-negative children received Rh-positive blood. These would range from 17 to 31 years of age at time of survey.	

\*Includes 3 Rh (D) positive women.

In Table IV are given the results of pregnancies in a series of mothers after they had been sensitized by transfusions. As far as could be determined, all the infants that were normal were so because of the fact that the father was heterozygous. If one excludes this group it may be seen that over one-fourth of the pregnancies terminated in the stillbirth of an erythroblastotic infant.

TABLE IV. ERYTHROBLASTOSIS FETALIS. MOTHERS ISOIMMUNIZED BY TRANSFUSION. RESULTS SUBSEQUENT TO ISOIMMUNIZING TRANSFUSION. TOTAL NUMBER OF MOTHERS 83\*

TOTAL PREGNANCIES	NORMAL INFANTS	MISCARRIAGES AND ABORTIONS	ERYTHROBLASTOSIS FETALIS	
			STILLBIRTHS	LIVE BIRTHS
201	59	26	40	76

\*Excludes 8 Rh (D) negative women married to Rh (D) negative husbands.

In Table V, it may be seen that in those affected infants that were born alive the case wastage rate is considerably higher than for the whole group (Table XII) in regard to both death and kernicterus in survivals.

TABLE V. ERYTHROBLASTOTIC INFANTS BORN ALIVE

TOTAL CASES	SURVIVAL NORMAL	DEATH	KERNICTERUS IN SURVIVALS	CASE WASTAGE RATE
76	43	28	5	43%

**Effect of Pregnancy Sequence in Pregnancy-Induced Isoimmunization**

In Table VI are presented the obstetrical histories of 661 women sensitized by pregnancy in which reasonably accurate data could be obtained. This table merely indicates the over-all picture and no attempt has been made to separate the women in regard to the pregnancy in which sensitization occurred or as to whether their husbands were homozygous or heterozygous.

TABLE VI. OBSTETRICAL HISTORY OF MOTHERS ISOIMMUNIZED BY PREGNANCY TO ONE OR MORE OF THE RH FACTORS. TOTAL 661

PREG-NANCY SEQUENCE	NORMAL INFANTS BORN	ABORTIONS, MIS-CARRIAGES, STILL-BIRTHS, AND ACCIDENTS OF BIRTH UNRELATED TO ERYTHROBLASTOSIS	ERYTHROBLASTOSIS FETALIS				
			% OCCUR-RENCE IN EACH PREG-NANCY	SURVIVAL NORMAL	STILL-BIRTHS	DEATH AND KERNIC-TERUS	% WASTAGE
1	572	77	1.8	4	3	5	66
2	304	76	39	195	9	38	19
3	135	84	54	150	36	73	42
4	63	53	56	94	27	35	40
5	41	31	52	35	15	29	55
6	16	21	55	24	9	12	47
7	17	5	48	12	4	3	40
8	6	7	-	8	5	-	-
9	2	-	-	4	3	1	-
10	3	-	-	3	3	-	-
11	-	-	-	-	1	-	-
12	1	-	-	-	-	-	-

Pregnancy-induced Rh isoimmunization in the first pregnancy is usually not of clinical significance and rarely results in an erythroblastotic infant. However, in our opinion, such cases do occur occasionally. It might be argued that these women who had an involved infant in the first pregnancy had either received an unknown injection or transfusion of blood as an infant, or were concealing a previous pregnancy. However, all the women in this group were requested to find out from their parents if there was any possibility of a transfusion in early childhood and in each case the reply was negative. Unless one has completely lost faith in human veracity it is presumed that at least some of these mothers were rendering true obstetrical histories. From our figures, if an Rh-negative woman belongs to the 5 to 6 per cent that will at some time be sensitized by their Rh-positive fetuses, there is approximately a 2 per cent chance that this will occur in the first pregnancy.

An erythroblastotic infant occurring in the first pregnancy must indicate a "hyper-isoimmunizability" of the mother, possibly in combination with a particularly potent D antigen in the fetus. Although in our series the number of erythroblastotic infants born in the first pregnancy is small, the indications



are that the disease is particularly severe as indicated by the high case wastage rate. Similar findings have been recently reported by Hartmann and Brendemoen.<sup>5</sup>

Numerically the largest number of fetuses and infants suffering from erythroblastosis appears in the second pregnancy. However, percentagewise, when the total number of second pregnancies in a group of sensitized women is considered there are proportionately somewhat fewer affected infants (approximately 40 per cent) than in subsequent pregnancies (50 to 55 per cent). A feature which is revealed in our figures is that when erythroblastosis occurs in the second pregnancy it is a considerably milder and less lethal disease than in subsequent pregnancies. It appears that in women potentially able to be sensitized the process of isoimmunization, in a large proportion at least, requires more than one pregnancy and even in the second pregnancy this process does not reach the intensity which it does in subsequent pregnancies. When results of treatment or case fatality rate is discussed in regard to a series of erythroblastotic infants, theoretically at least, the proportion of second-pregnancy infants in that series should be considered. It is likely that, in a population where local customs, economic conditions, or religious persuasion predispose to large families, there would be a higher proportion of infants born with severe erythroblastosis.

Although the total number of pregnancies rapidly diminishes, it would appear from our data that the appearance rate of fetuses affected with erythroblastosis is fairly constant in pregnancies after the second, and that this rate is approximated 50 to 55 per cent. Furthermore, although in the individual women there is an increase in the severity of the disease from the third pregnancy on, percentagewise this does not materially increase for the group as a whole. The women with erythroblastotic fetuses in the third pregnancy and later are in all probability a mixed group composed of those with heterozygous husbands, those not particularly susceptible to isoimmunization, and those who are having a series of erythroblastotic babies.

#### **Effect of ABO Incompatibility on Rh Isoimmunization**

Levine<sup>6</sup> first drew attention to the curious fact that incompatibility in the ABO system between the fetus and the mother seemed to protect against Rh sensitization and that mothers of infants with hemolytic disease were more frequently compatibly mated in regard to the ABO system than were unselected women. This has been subsequently confirmed on several occasions.<sup>7</sup>

This phenomenon is also demonstrated in our series. In Table VII, there are listed 481 mothers sensitized by pregnancy where the ABO groupings of both the mother and her husband were known ( $A_1$  and  $A_2$  are all grouped under A). Expected matings in the random population where ABO incompatibility between the mother and her fetus is possible would be 33.5 per cent. The number actually observed amounted to only 18.4 per cent. In Table VIII is shown the actual distribution of 451 erythroblastotic infants in respect to their ABO grouping and whether or not they were incompatible in

the same system with their mothers. It can be calculated that the expected percentage of infants in the random population incompatible with their mothers is 19.8 per cent. The actual percentage of erythroblastotic infants obtained was 7.8 per cent. Furthermore, the ABO distribution of the erythroblastotic infants does not conform to that of the general population, there being fewer A, B, and AB's. It would seem that if only Rh incompatibility were effective, down through the ages there would be a gradual tendency toward the elimination of O infants as more of these would die from erythroblastosis. This effect is, however, no doubt, nicely balanced by the tendency for A, B, and AB to be eliminated in those cases of hemolytic disease of the newborn resulting from ABO incompatibility.

TABLE VII. EFFECT OF ABO INCOMPATIBILITY ON RH ISOIMMUNIZATION FINDINGS IN 481 MOTHERS RH SENSITIZED BY PREGNANCY WHERE THE ABO GROUPINGS OF BOTH FATHER AND MOTHER WERE KNOWN

MATINGS WHERE ABO INCOMPATIBILITY POSSIBLE		EXPECTED % IN RANDOM POPULATION*	NUMBER OF SENSITIZED MOTHERS	% OF TOTAL NUMBER SENSITIZED MOTHERS
FEMALE	MALE			
O	A	18.0	44	9.1
O	B	4.5	12	2.5
O	AB	1.6	4	0.8
A	B	3.8	15	3.1
A	AB	1.4	2	0.4
B	A	3.8	12	2.5
B	AB	0.35	0	0
Total		33.5		18.4

\*Based on ABO groupings of 1,000 children over 6 months of age in The Hospital for Sick Children, Toronto.

TABLE VIII. EFFECT OF ABO INCOMPATIBILITY ON RH ISOIMMUNIZATION WHERE THE ABO GROUPINGS OF ERYTHROBLASTOTIC INFANT AND MOTHER WERE KNOWN  
TOTAL 451 INFANTS

ABO GROUP OF INFANTS	ALL ERYTHROBLASTOTIC INFANTS			ERYTHROBLASTOTIC INFANTS COMPATIBLE WITH MOTHER			ERYTHROBLASTOTIC INFANTS INCOMPATIBLE WITH MOTHER		
	NUMBER OF INFANTS	ACTUAL PERCENT-AGE	EXPECTED RANDOM POPULATION*	NUMBER OF INFANTS	ACTUAL PERCENT-AGE	EXPECTED RANDOM POPULATION	NUMBER OF INFANTS	ACTUAL PERCENT-AGE	EXPECTED RANDOM POPULATION
O	232	51.2%	46.9%	232	51.2%	46.9%	None	-	None
A	179	39.2%	39.9%	160	35.0%	27.2%	19	4.2%	12.7%
B	30	6.7%	9.7%	22	4.9%	5.4%	8	1.8%	4.3%
AB	10	2.9%	3.5%	2	1.1%	0.7%	8	1.8%	2.8%
Total	451	100%	100%	416	92.2%	80.2%	35	7.8%	19.8%

\*Based on ABO groupings of 1,000 children over 6 months of age in The Hospital for Sick Children, Toronto.

Although the number of cases is not large, an analysis of infants with hemolytic disease who are incompatible in the ABO system with their mothers suggested that these infants as a class were less severely affected than the average even in those cases in which the sensitization was transfusion induced (Table IX). There were no cases of kernicterus and the average case wastage rate was only 13 per cent in comparison with over 20 per cent for all cases admitted to the hospital.

TABLE IX. RH ISOIMMUNIZATION AND ABO INCOMPATIBILITY. INFANTS WITH ERYTHROBLASTOSIS AND ABO INCOMPATIBILITY WITH THEIR MOTHER

TOTAL INFANTS	SURVIVAL NORMAL	DEATH	KERNICTERUS IN SURVIVALS	CASE WASTAGE RATE
<i>Pregnancy-induced isoimmunization.—</i>				
35	30	5	0	14%
<i>Transfusion-induced isoimmunization.—</i>				
18	16	2	0	11%

Three explanations have been suggested to explain the effect of the ABO groups on the production of Rh antibodies. The first has received attention because of its possible bearing on the problem of prevention of Rh sensitization. This postulates that if the fetus is, for example, A, and the mother O, the mother's tissues are too fully occupied making more Anti-A to fabricate Anti-Rh. This is the basis for giving typhoid and other antigens to sensitized women in the hope that the production of Rh antibodies will be reduced to a minimum. It is our impression that if an individual can make one antibody she is equally capable of making one or several others. A second explanation is that there is a tendency toward the elimination of incompatible ABO fetuses in all pregnancies irrespective of the Rh groups. As many of these fetuses are eliminated early in pregnancy they would not be so effective in stimulating the production of Rh antibodies as those which are ABO compatible. The third and most plausible explanation is, if we assume that sensitization is due to fetal cells entering the maternal circulation, that in the case of ABO incompatibility the incompatible fetal cells are rapidly hemolyzed and eliminated by the naturally occurring antibodies in the mother before they have time to act as an Rh antigen. Even in those cases where the Rh isoimmunization is due to a transfusion, the incompatible fetal cell may be eliminated too rapidly to act as an efficient antigen to boost the level of Rh antibodies.

#### Treatment of Erythroblastosis Fetalis

During the six-year period from January, 1947, to December, 1952, a total of 512 infants with congenital hemolytic anemia were admitted alive to the hospital. It requires a minimum of approximately one hour from the time of birth in one of the adult hospitals until admission to a ward of The Hospital for Sick Children. Thus, all infants admitted had survived for at least one hour. They included both public and private patients, and were admitted under a number of different clinicians. Treatment varied considerably, chiefly dependent upon the clinical appraisal of the case, the time of admission, and also the current concepts of the preferred treatment by the attending pediatrician. In all cases treatment was carried out by assistant residents (senior interns), under the supervision of the resident. Except in a few cases of erythroblastotic infants born to Rh-positive mothers, where suitable compatible blood was used, the infant was transfused with compatible Rh-negative blood. If O blood was used on an infant other than Group O, the blood was "neutralized" with A and B substances. For a short time, female blood was

used, but, as there were no apparent benefits, and as female Rh-negative blood was difficult to obtain, this refinement was abandoned. The technique evolved for doing a replacement transfusion was withdrawal of the blood from the umbilical vein and infusion into the long saphenous vein.

There was a small group of 36 infants (Table X) who received no treatment. These fell into two classes. First, those who, although admitted alive, succumbed before treatment could be made available; and second, those cases which were judged on a clinical and laboratory basis as being too mild to warrant treatment. All of these latter survived but one of the disquieting features was that, in spite of minimal evidence of disease in the neonatal period, two of the 21 infants on subsequent examination had neurological sequelae which were judged to be the result of kernicterus.

TABLE X. ERYTHROBLASTOSIS FETALIS. ALL INFANTS ADMITTED ALIVE TO THE HOSPITAL FOR SICK CHILDREN, PERIOD JANUARY, 1947-DECEMBER, 1952. TOTAL 512 INFANTS

YEAR	NO. OF IN- FANTS	NOT TREATED			REPLACEMENTS AND SIMPLE TRANSFUSIONS				SIMPLE TRANSFUSIONS			
		TOO SEVERE, ALL DIED	MILD	KERN. IN SUR- VIVALS	SUR- VIVALS	KERN. IN SUR- VIVALS	DEATH	CASE WASTAGE RATE %*	SUR- VIVALS	KERN. IN SUR- VIVALS	DEATH	CASE WASTAGE RATE %*
1947	53	5	-	-	13	-	2	13	27	3	6	27
1948	64	-	3	1	32	2	7	23	18	1	4	23
1949	68	1	1	-	31	1	8	23	21	3	6	33
1950	92	2	4	-	36	1	7	18	34	1	9	24
1951	98	4	7	1	36	4	6	14	40	2	5	16
1952	137	3	6	-	56	-	10	15	54	2	8	16
Total	512	15	21	2	204	8	40	19.5	194	12	38	22.5

\*Includes deaths and kernicterus in survivals.

Of the remaining 476 infants, 232 were treated with one or multiple simple transfusions, and 244 with a replacement transfusion followed by repeated simple transfusions if they were considered necessary. Aside from the basic difference in the method of treatment with blood, both groups of children received the same fundamental care. The necessary manipulations and operative procedures were performed by different individuals throughout the series. However, in consideration of a close supervision, the procedures were carried out with adequate skill and dexterity. No attempt was made to treat alternate cases with the two types of treatment. The particular treatment an infant received was determined by the opinion and judgment of the pediatrician in charge of the case. In many cases the age of the patient on admission was the deciding factor. If the umbilical vein was thrombosed, simple transfusions only were given. Due to differences in the opinion of the attending staff as to the effectiveness of simple transfusions versus replacement transfusions, it turned out that the series of cases treated by the two methods were fairly well balanced. Table X also lists the treated cases. No case has been excluded if the infant was breathing when treatment was started. A few were moribund on admission; nevertheless treatment was initiated in the hope that possibly something might be done for the child. In an occasional replace-



ment technical difficulties were encountered and the procedures could not be satisfactorily completed. Such cases were, however, placed in the replacement series, as it was considered that this should be regarded as one of the hazards of the procedure. From our over-all figures, the divergence in the opinion of the pediatricians as to the better method of treatment is easily understood. There seems to be very little to choose between the two types of treatment. The case fatality rate in each group is approximately 16 per cent. In agreement with Allen and associates,<sup>8</sup> however, there appeared to be a significantly lower incidence of kernicterus in the surviving infants who had received a replacement transfusion than in those who had received simple transfusions, e.g., 3.9 and 6.5 per cent, respectively. The difference in the total case wastage rates which included the deaths and kernicterus in the two groups is almost entirely due to the lower incidence of kernicterus in the replacement group. Table XI summarizes the experience with all cases of erythroblastosis treated during the period of the study.

TABLE XI. ERYTHROBLASTOSIS FETALIS. ALL CASES TREATED IN HOSPITAL. TOTAL 476

	ORDINARY TRANSFUSIONS	REPLACEMENTS AND REPLACEMENTS + ORDINARY TRANSFUSIONS
Case wastage rate	22.5%	19.5%
Kernicterus survivals	6.2%	3.9%

Theoretically, replacement transfusion, except in the milder cases, would appear to be the treatment of choice. Although it possibly has no effect on the liver and other damaged tissues, and the ability of the bone marrow to maintain the postnatal production of erythrocytes, it does remove a large mass of damaged cells. There is reasonably good evidence that, in an erythroblastotic infant who is born alive, the lethal effects of the disease, particularly kernicterus, are associated with rapid dissolution of a large number of red cells and the concomitant jaundice. It appears that the replacement of these damaged erythrocytes by undamaged nonsusceptible cells would be a logical therapeutic procedure. However, much has been written concerning the merits and drawbacks of replacement transfusion and its value is possibly not of the magnitude nor so clear-cut as many of its proponents would like one to believe.

Following the general principles adopted by Mollison and Walker,<sup>9</sup> an attempt was made to compare our series of replacement and simple transfusions by excluding all those infants who had not received treatment within 12 hours of birth. To exclude the possibility that mild cases tended to be treated by simple transfusion and the more severe by means of replacement transfusion, the cases were rated as premature (under 5½ pounds), severe, moderate, and mild cases (Table XII). Although the proportions in each category treated by the two methods were comparable, over twice as many of the infants who were treated early were treated by replacement transfusion. The reason for this is that, in many of the infants admitted more than 24 hours

after birth, the umbilical vein was firmly thrombosed and it was judged that a replacement transfusion was not feasible. Even though there was a total of 207 infants treated within 12 hours of age, the number that turned up in each category of severity was too small for the figures to be of any significance. However, the results in the total group with each type of treatment are summarized in Table XIII. It is seen that, in regard to total case wastage rate, kernicterus in survivals, and the average hospital stay of the survivals, replacement transfusion supplemented with simple transfusions, if necessary, made a better showing on all counts than simple transfusions alone. Thus it would appear that replacement transfusion, although not the complete answer to the problem of erythroblastosis, is, with the possible exception of mild cases, the treatment of choice.

TABLE XII. ERYTHROBLASTOSIS FETALIS. ADMITTED AND RECEIVED TREATMENT WITHIN TWELVE HOURS OF BIRTH. TOTAL 207

CATEGORY	ORDINARY TRANSFUSIONS				REPLACEMENTS AND REPLACEMENTS + ORDINARY TRANSFUSIONS			
	NUMBER OF CASES	DEATHS	KERNIC- TERUS	AVERAGE HOSPITAL STAY OF SURVIVALS DAYS	NUMBER OF CASES	DEATHS	KERNIC- TERUS	AVERAGE HOSPITAL STAY OF SURVIVALS DAYS
Premature	9	5	0	17	14	6	0	25
Severe	13	7	0	17.5	44	16	2	13
Moderate	30	3	2	20	64	1	1	14
Mild	8	1	1	10	25	3	1	15
Total	60	16	3	17.8	147	26	4	14.7

TABLE XIII. ERYTHROBLASTOSIS FETALIS. ADMITTED AND RECEIVED TREATMENT WITHIN TWELVE HOURS OF BIRTH

	ORDINARY TRANSFUSIONS	REPLACEMENTS AND REPLACEMENTS + ORDINARY TRANSFUSIONS
Case wastage rate	32%	20%
Kernicterus in survivals	6.8%	3.3%
Average hospital stay of survivals	17.8 days	14.7 days

### Prematurity

In our series the premature group had the highest mortality rates (Table XIV). This is in agreement with reports from other centers. For a while, because of the reasoning that the major damage to the infant's erythrocytes by the maternal antibodies was in the last month or so of pregnancy, it was advocated that pregnancy be terminated about the eighth month. This procedure is no longer favored in most centers, as it is considered that the hazards of prematurity outweigh the possibility of extra damage occasioned by the longer exposure to the maternal antibodies. The evidence shows that, unless there are other obstetrical reasons, the pregnancy in sensitized women had best be allowed to go to term.

TABLE XIV. ERYTHROBLASTOSIS FETALIS. PREMATURITY, LESS THAN 5½ POUNDS AT BIRTH

TOTAL CASES	SURVIVAL NORMAL	DEATH	KERNICTERUS IN SURVIVALS	CASE WASTAGE RATE
48	26	22	2	50%

### Kernicterus

The end result of kernicterus with its tragic social and economic problems is the most severe and dreaded sequel of erythroblastosis. In our experience, replacement transfusion has reduced the incidence of this complication but has not completely eradicated it. Although kernicterus is almost invariably associated with severe jaundice, neurological changes turned up in the form of mental retardation in two children whose cases were considered too mild to warrant any form of treatment. Perhaps if repeated replacements had been undertaken more frequently to keep the development of jaundice to a minimum, the incidence of kernicterus would have been further reduced. The incidence of kernicterus in surviving children is shown in Table XV. The relatively high rate in children born of mothers immunized by transfusions is no doubt an index of the severity of the disease under these conditions.

TABLE XV. ERYTHROBLASTOSIS FETALIS. KERNICTERUS IN SURVIVING INFANTS

TOTAL NUMBER	NUMBER WITH KERNICTERUS	%
Prematures	28	6.9
Mature	391	4.9
Mother isoimmunized by transfusion	48	10.4

Although it has been stated<sup>7</sup> that prematurity predisposes to kernicterus, this is not strikingly apparent in our relatively small series of surviving premature erythroblastotic infants. Furthermore, in our experience, the incidence of kernicterus in the premature at post-mortem is less than in the mature infant. Here again the number of cases is small (Table XVI). However, 6 of these infants died within 36 hours of birth and kernicterus would not have developed by this time.

TABLE XVI. KERNICTERUS AT POST-MORTEM  
TOTAL NUMBER OF DEATHS 93

TOTAL NUMBER OF POST MORTEMES	NUMBER WITH KERNICTERUS	%
Premature	16	25
Mature	56	37
Total	72	25

### Hemolytic Disease of the Newborn Due to ABO Incompatibility

Diagnosis of this type of erythroblastosis was based on the following data. Clinically the infant presented the picture of erythroblastosis. The infant's cells reacted negatively to the Coombs test. There was no evidence of Rh incompatibility between the mother's and the infant's blood. There was evidence of ABO incompatibility between the mother and infant and the

mother demonstrated a significant titer of antibodies against the infant's cells suspended in AB serum after neutralization with A and B substances.

Prior to the middle of 1951 this routine was not carried out in all cases of congenital hemolytic anemia suspected of being due to ABO incompatibility and hence some cases were no doubt missed and no accurate estimation of the incidence of this type of erythroblastosis can be given. In Table XVII are listed the 18 cases encountered in approximately a year and a half. In Toronto, during the eighteen-month period under consideration, approximately 37,500 infants were born. Approximately 20 per cent, or 7,500, of these infants would be expected to be incompatible in the ABO system with their mothers. Hence, the incidence of this type of disease must be low.

TABLE XVII. ERYTHROBLASTOSIS FETALIS DUE TO ABO INCOMPATIBILITY

Number of cases (in all mother Group O)	18
Blood group of infants	A 12 B 6
Survivals normal	11
Kernicterus	1
Stillborn	4
Died	2

The number of cases of hemolytic disease due to this type of incompatibility is small but it would appear that the disease, when it occurs, is no less severe than erythroblastosis due to Rh incompatibility.

### Sex Incidence in Erythroblastosis

In Table XVIII is given the sex incidence in our series of erythroblastotic infants and also the sex incidence for all infants born in Toronto in 1950. There is no satisfactory explanation for the slight male preponderance.

TABLE XVIII. ERYTHROBLASTOSIS FETALIS. SEX DISTRIBUTION OF INFANTS ADMITTED TO THE HOSPITAL FOR SICK CHILDREN

	THE HOSPITAL FOR SICK CHILDREN		TORONTO 1950
Males	279	54.5%	52%
Females	233	45.5%	48%
Total	512	100%	100%

### Summary and Conclusions

1. In pregnancy, the major clinically significant isoimmunization is in the Rh (D) negative mother and the important sensitized factor is D.

2. A particularly severe type of isoimmunization is induced by transfusion, especially if the transfusion occurs after puberty. If an Rh (D) negative female infant or child received Rh-positive blood, the results may not be so serious as hitherto suspected.

3. A mother may have a surviving normal erythroblastotic infant subsequent to one that died.

4. ABO incompatibility of a mother with her infant protects against Rh isoimmunization and if sensitization does occur the disease of the infant is relatively mild.



5. Clinical erythroblastosis appears most frequently and in its most benign form in the second pregnancy.

6. Erythroblastosis is slightly more common in male than in female infants.

7. The severity of the disease in infants is affected by many factors: (a) the sequence of pregnancy; (b) ABO incompatibility between mother and infant; (c) prematurity; (d) whether isoimmunization was induced by pregnancy or transfusion.

All of these should, if possible, be taken into account in the assessment of any form of treatment.

8. Exchange transfusion appears to be the treatment of choice except possibly in mild cases.

9. Kernicterus is the one severe sequel to erythroblastosis. According to our figures, there is a significant decrease in the incidence with replacement transfusions. As kernicterus rarely manifests itself before 36 hours of age, the answer to the problem is early treatment and possibly repeated replacement if jaundice appears to be impending.

10. ABO incompatibility is a mixed blessing. It rarely causes disease by itself, but it also protects against Rh isoimmunization.

We wish to thank the following members of the Toronto Rh Committee without whose cooperation it would have been impossible to gather the necessary data: Drs. Philip Greey (Chairman) and D. M. Low, Toronto General Hospital; Drs. F. P. McInnis and T. H. Hawks, St. Michael's Hospital; Drs. L. T. Armstrong and C. R. McLean, Toronto Western Hospital; Major Margaret Crosbie, Grace Hospital; Dr. H. G. Pritzker, Mount Sinai; Dr. L. S. Mautner, St. Joseph's Hospital; Dr. S. F. Penny, Toronto East General Hospital; Dr. T. C. Brown, Wellesley Hospital; Dr. Alice Gray, Women's College Hospital.

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## THE OBSTETRICAL MANAGEMENT OF THE Rh-NEGATIVE PATIENT\*

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A SURVEY of the Rh problem and determination of the incidence of Rh isoimmunization in obstetrical patients of the Toronto area was undertaken in September, 1946, by an Rh Survey Committee established under the joint auspices of the Department of Obstetrics and Gynecology in the Faculty of Medicine, University of Toronto, and nine Toronto hospitals. This committee functioned actively for the years 1947 and 1948 and the plan then established for determination of Rh factor and detection of isoimmunization has become a routine in prenatal care.

More than five years having elapsed since the survey began, it was felt that an attempt should be made to follow up the progress, state of health, and development of as many as possible of these infants who survived treatment for congenital hemolytic disease. This aspect is covered in the companion paper by Donohue and Snelling.

In this present paper I have used the figures obtained from two of the Toronto hospitals to show the percentage of Rh-negative obstetrical patients found in this area and the incidence of isoimmunization in these patients. I have also from my own record of 490 consecutive private obstetrical patients attempted to demonstrate what I believe are the essentials in management of the Rh-negative obstetrical patient.

Although it is estimated that during the six-year period 1947 to 1952 there were over 150,000 Rh-factor determinations made, it was found impossible to obtain accurate records from all the hospitals. For this reason the only figures reported are from one large teaching hospital, one nonteaching hospital, and the small series of private patients of whom accurate knowledge is possessed.

TABLE I. INCIDENCE OF RH ISOIMMUNIZATION

SERIES	PATIENTS	Rh NEGATIVE	ISOIMMUN.
Baltimore series <sup>1</sup>	69,356	13,167 18.9%	622 4.7%
Oslo series <sup>2</sup>	75,000	11,250 15%	562 5%
Toronto hospital			
A	12,372	1,827	131
B	12,322	1,972	87
	24,694	15.3%	5.7%
Toronto Practice	490	86 17.5%	7 8.1%

\*Read at the Ninth Annual Meeting of the Society of Obstetricians and Gynaecologists of Canada, Wellesley Island, N. Y., June 5 to 7, 1953.

As will be noted in Table I there were Rh-factor determinations carried out on 24,694 patients in the two hospitals selected and 3,799 of these patients proved to be Rh negative. Of these 3,799 patients 218, or 5.7 per cent, gave evidence of isoimmunization. These figures closely parallel those of the Baltimore<sup>1</sup> and Oslo<sup>2</sup> surveys.

Of the 490 private patients, 86 patients (17.5 per cent) proved to be Rh negative and 7 (8.1 per cent) of these Rh-negative patients gave evidence of isoimmunization. There was also one Rh-positive patient who showed isoimmunization apparently due to Anti-A, and gave birth to a hydropic infant. This series shows a higher incidence of isoimmunization because of the small numbers and also because of the fact that 3 already proved cases of isoimmunization were referred from outside the Toronto area. If these 3 cases were excluded, the incidence of isoimmunization including the Rh-positive patient would be 5 in 84, or 5.8 per cent.

TABLE II. CLINICAL DATA, TORONTO PRACTICE, 490 PATIENTS

MOTHER				INFANT		
BLOOD GROUP	AVERAGE HEMOGLOBIN LEVEL	POSITIVE WASSERMANN TEST	WEIGHT			
O	48.4%	82%	0	7.9 pounds	53%	47%
A	39.4%					
B	9.1%					
AB	3.0%					

In this series of 490 private patients, as seen in Table II, it is interesting to note that there were no positive Wassermann tests, which appears to be evidence of the almost negligible incidence of syphilis in the type of patient met with in the average private practice. It is also evident that the state of nutrition in this group was excellent if the average hemoglobin level of 82 per cent taken at 16 to 20 weeks is any criterion. The blood grouping of these patients conforms to that of the random population, namely, 48.4 per cent Group O, 39.4 per cent Group A, 9.1 per cent Group B, and 3.0 per cent Group AB. The average weight of these infants at birth was surprisingly high, namely, 7 pounds, 15 ounces, and the ratio of male to female was 53 to 47 per cent.

TABLE III. RELATION OF PARITY AND ISOIMMUNIZATION

First pregnancy	1
Second pregnancy	2
Third pregnancy	4
Sixth pregnancy	1

Of the seven Rh-negative patients who showed isoimmunization, this occurred in one case with a first pregnancy, in one with the second pregnancy, in four with the third pregnancy, and in one with the sixth pregnancy. In the Rh-positive patient isoimmunization due to Anti-A occurred with the second pregnancy.

As shown in Table IV there were 4 Rh-negative women isoimmunized by pregnancy and 3 by previous transfusion. The one Rh-positive woman who

showed isoimmunization gave birth to a hydropic infant apparently due to ABO incompatibility.

As also shown in Table IV, 4 of the 8 infants suffering from congenital hemolytic disease did not survive. However, since there were two cases of hydrops and one of death in utero with macerated fetus, there was only one death in the remaining five where treatment was possible. This was the death of an infant who had survived a replacement transfusion but died two months later. The mother was pregnant for the first time and the father was found to be homozygous. There have been two pregnancies since of this mating, and in both the baby died in utero. It is apparently not common (2 to 5 per cent) to find congenital hemolytic disease in the infant during a first pregnancy but this case suggests that when it does occur it is usually to a severe degree.

TABLE IV. TYPE OF IMMUNIZATION AND FETAL MORTALITY

	NO.	MORTALITY
Rh neg., isoimmunized by pregnancy	4	3
Rh neg., isoimmunized by transfusion	3	0
Rh pos., immunized due to Anti-A	1	1

As shown in Table V, 77 of the 86 Rh-negative patients were allowed to go into spontaneous labor at or near term. The pregnancy of the one Rh-positive patient was terminated at 32 weeks by artificial rupture of the membranes because of acute hydramnios.

TABLE V. MODE OF DELIVERY, 86 PATIENTS

Spontaneous labor	77
Premature induction	1
Cesarean section (none for Rh)	8

Although there were 8 patients delivered by cesarean section within 2 to 3 weeks of term, in no instance was section performed because of Rh-factor incompatibility. The indications were all for other obstetrical reasons, namely, previous section in 5 cases, complete placenta previa in 1 case, large obstructing fibroids in 1 case, and cephalopelvic disproportion after a test of labor in 1 case. I am somewhat apologetic in having to report such a high proportion of cesarean sections in this small series but to be truthful they must appear. I would like to state that, including repeat sections, during the same period of time my over-all incidence of section in private practice has varied between 3.9 and 5.8 per cent.

Of the 8 infants suffering from congenital hemolytic disease, 5 mothers were allowed to go into spontaneous labor at or near term, 2 were delivered by cesarean section because of previous section, and one by artificial rupture of the membranes at 32 weeks.

### Summary of Obstetrical Management of the Rh-Negative Mother

1. The fear of development of congenital hemolytic disease in infants should be allayed in the minds of Rh-negative mothers.



2. All obstetrical patients at or about 16 to 20 weeks should have Rh-factor determinations made and if they are found to be Rh negative should be tested for antibodies.

3. If antibodies are present a recheck as to titer should be made at about 30 to 34 weeks.

4. In all cases of isoimmunization and especially where one or more infants have been born suffering with or have died of congenital hemolytic disease, an attempt should be made to determine the Rh subtype of the father to aid in giving prognosis in the event of future pregnancy. If any living children of this mating should be proved Rh negative, it may be assumed that the husband is heterozygous.

5. Even if the father is homozygous, the mother Rh negative isoimmunized, and a previous history is given of one or more stillbirths or neonatal deaths because of hemolytic disease, therapeutic abortion is not advised since live births or survival following treatment during the neonatal period may still occur. However, if in such cases contraceptive measures are not possible or accepted, tubal sterilization might be considered.

6. All Rh-negative patients are allowed to go into spontaneous labor at term if possible unless artificial rupture of the membranes or cesarean section at or prior to term is indicated for other obstetrical reasons.

7. A sample of cord blood for the Coombs test is taken at birth of all infants born of Rh-negative mothers who show antibodies. Care is taken in such cases to clamp the cord about three inches from the navel to facilitate transfusion if this is found necessary.

8. Replacement transfusion is carried out as soon as possible after birth, preferably within 12 hours for those infants showing positive Coombs test.

#### **Summary of the Obstetrical Prognosis for the Rh-negative Mother**

1. The group of Rh-negative mothers who do not show antibodies present no problem.

2. The group of Rh-negative mothers who do show antibodies but have infants born with negative Coombs test have excellent prognosis as to survival of the infant.

3. The group of Rh-negative mothers who show antibodies and who have had an infant surviving treatment for hemolytic disease have no better than an even chance that the succeeding infant will likewise survive treatment.

4. The group of Rh-negative mothers who show antibodies and who have had previous stillbirth or neonatal death following failure of treatment for hemolytic disease will have only very slight chance of any succeeding infant surviving treatment for hemolytic disease.

#### **Conclusions**

Until some proved method is found of preventing the development of congenital hemolytic disease during the prenatal period it is evident that during this period Rh-negative mothers should have continuous observation and re-

peated reassurance. As a rule, they can be allowed to go into spontaneous labor at term. A Coombs test should be taken from the blood of all infants born of Rh-negative mothers who show isoimmunization. Immediate replacement transfusion offers a high salvage rate for those infants who show a positive Coombs test except in case of hydrops. The initial hysteria and fear aroused in the minds of obstetricians and Rh-negative obstetrical patients during the past decade should be allayed.

I wish to thank Dr. Alice E. W. Gray and Dr. John Dickenson for collecting the data from the two Toronto hospitals. Grateful acknowledgment is also made of the cooperation and assistance of Dr. W. J. Donohue, Dr. P. H. Greey, the late Professor H. B. Van Wyck, and Professor D. E. Cannell.

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## THE PROBLEM OF THE GRAND MULTIPARA\*

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**M**ULTIPARITY favors certain obstetrical difficulties which necessitate special concern for patients in that group. It was the special admonition of Dr. Arthur Bill, which I remember well from my postgraduate work in the University Hospital in Cleveland, to confine all cases of extreme plurality in the hospital rather than in their homes, as was the practice with the usual multiparous patient at that time.

Today, however, the grand multipara has truly become the vanishing American and it is difficult for a physician not associated with a large clinic practice to assay the problems of this type of patient from first-hand information and experience. Changes in family size which have occurred throughout the United States between the years 1920 and 1950 are depicted in Fig. 1. The five-child family group just holds its own while the larger ones slowly decline.

However, on visiting some of the European countries during World War II, I discovered that grand multiparity was still prevalent and that often no particular concern was felt for the extreme parity of some patients. Similarly, on several visits to our own Province of Quebec, I found that the grand multipara was more in evidence, and, in the modern clinics which I attended, her presence seemed to be taken as a matter of course, although with certain definite reservations. This point of view was in contrast to that of other excellent clinics in the United States where sterilization of all patients with eight previous viable pregnancies is advocated.

In an attempt to obtain a clear-cut picture of what particular complications were inherent in grand multiparity, I have reviewed the hospital records for the years 1950, 1951, and 1952 at Victoria Hospital and St. Joseph's Hospital in London, Ontario, and have compared them with an approximately equal number of cases from the University Hospitals in Cleveland, Ohio, representing their total births for the year 1952. This gave totals of 4,587 patients for Victoria Hospital, 5,993 patients for St. Joseph's Hospital, and 4,753 patients from the University Hospitals with a grand total of 15,333 patients investigated.

For the purposes of this paper, a grand multipara was considered to be any patient who had been delivered of seven or more viable children. In the group of patients studied, 502 were in this category, an incidence of 2.6 per cent.

\*Read at the Ninth Annual Meeting of the Society of Obstetricians and Gynaecologists of Canada, Wellesley Island, N. Y., June 5 to 7, 1953.

TABLE I. PERCENTAGE OCCURRENCE OF COMMON OBSTETRICAL COMPLICATIONS AMONG OBSTETRICAL

	VICTORIA PRIVATE				VICTORIA STAFF			
	TOTAL PATIENTS		GR. MULTIP.		TOTAL PATIENTS		GR. MULTIP.	
	NUM-BER	% WITH COMP.	NUM-BER	% WITH COMP.	NUM-BER	% WITH COMP.	NUM-BER	% WITH COMP.
Obstetrical Deliveries	3,795		79 (2%)		792		107 (13%)	
Malpresentations:								
Breech	127	3.3	1	1.3	26	3.3	4	3.6
Others	57	1.5	3	3.7	12	1.5	2	1.8
Accidental hemorrhage	31	0.8	2	2.5	9	1.3	3	2.83
Placenta previa	24	0.6	0	0	6	0.8	1	0.9
Postpartum hemorrhage	23	0.6	0	0	5	0.6	2	1.8
Retained placenta (manual removal)	70	1.8	2	2.5	11	1.4	4	3.6
Morbidity	111	2.9	3	3.7	26	3.3	2	1.8
Mortality	1		0	0	1		0	0
Late toxemias	155	4.0	3	3.7	50	6.3	20	18.6
Premature labor	235	6.2	3	3.7	60	7.6	10	9.3
Stillbirths	75	2.0	2	2.5	19	2.4	7	3.3
Neonatal deaths	46	1.2	1	1.3	21	2.7	4	3.6
Twins	37	1.0	0	0	8	1.1	0	0
Fetal abnormalities	36	0.9	2	2.5	8	1.1	3	2.8
Operative complications								
Low-mid to high forceps	93	2.4	1	1.3	4	0.5	1	0.9
Cesarean Section	218	5.7	0	0	36	4.5	1	0.9
Lacerations repaired	316	8.3	1	1.3	Combined with Private			
Episiotomies	1,631	43.0	0	0				

### Obstetrical Complications

A contrast between the general incidence of obstetrical complications and the frequency of these complications in the grand multipara is shown in Table I. It will be seen in column I of Table I that in 3,795 private deliveries at Victoria Hospital there were 79 grand multiparas, an incidence of 2 per cent; on the staff service of this hospital 792 patients were delivered, 107 of these being grand multiparas, giving an incidence of 13 per cent. At St. Joseph's Hospital, there were 5,993 deliveries on the combined private and staff services and 210 of these were grand multiparas, giving an incidence of 3.7 per cent. In the Cleveland University Hospitals' services 4,753 patients were delivered with 106 of them grand multiparas, giving an incidence of 2 per cent. It was rather remarkable how closely the figures tallied for grand multiparas in all three institutions concerned.

The private and staff services at Victoria Hospital were considered as separate entities in order to show the effect of social status upon multiparity. In this small series it was found that only 2 per cent of the private cases were grand multiparas, whereas 13 per cent of the staff patients were in this category. For purposes of completeness each hospital is given separately but the fifth double column of the table indicates the grand totals of all deliveries at the hospitals compared with the total for all pluriparous patients delivered and gives the percentage of the complications occurring in each group.



## PATIENTS AND PERCENTAGE OCCURRENCE OF THESE COMPLICATIONS IN GRAND MULTIPARAS

ST. JOSEPH'S COMBINED				CLEVELAND UNIV. HOSP.				GRAND TOTALS			
TOTAL PATIENTS		GR. MULTIP.		TOTAL PATIENTS		GR. MULTIP.		TOTAL PATIENTS		GR. MULTIP.	
NUM- BER	% WITH COMP.	NUM- BER	WITH COMP.	NUM- BER	% WITH COMP.	NUM- BER	% WITH COMP.	NUM- BER	% WITH COMP.	NUM- BER	WITH COMP.
5,993		210 (3.7%)		4,753		106 (2%)		15,333		502 (2.6%)	
228	3.8	2	.95	208	4.4	3	2.7	589	3.8	10	1.9
88	1.4	4	1.9	29	0.6	1	0.94	183	1.1	10	1.9
56	0.9	3	1.4	88	1.8	4	3.77	184	1.2	12	2.39
17	0.3	0	0	14	0.3	2	1.8	61	0.4	3	0.6
28	0.48	0	0	40	0.8	1	0.94	96	0.6	3	0.6
90	1.5	5	2.4	74	1.5	4	3.77	245	1.6	15	2.9
132	2.2	5	2.4	106	2.2	5	4.7	375	2.4	15	3.0
3		0	0	3	0.08	1	0.94	9	0.06	2	0.4
292	4.87	24	11.4	246	5.2	9	8.5	743	4.1	56	11.1
156	2.6	5	2.4	401	8.2	12	11.3	852	5.6	30	5.9
109	1.8	18	8.5	101	2.1	6	5.66	304	1.9	27	3.18
127	2.1	6	2.8	44	0.9	4	3.77	238	1.5	15	3.0
76	1.1	11	5.4	61	1.2	1	0.94	182	1.2	12	2.4
58	0.96	5	2.4	55	1.1	2	1.8	157	1.02	12	2.3
				928	19.5	5	4.7	1,032	11.0	7	0.06
153	2.55	2	0.95	272	5.8	3	2.7	679	4.5	6	1.05
	Not			471	9.9	2	1.8	787	9.0	3	0.5
	Investigated			2,991	62.9	3	2.7	4,622	52.0	3	0.5

*Malpresentations* were actually slightly less frequent than in the general group. Breech presentation occurred in 3.8 per cent of the general group as compared with 1.9 per cent of the grand multiparas. Other malpresentations such as face, brow, and transverse were found in 1.1 per cent of the general cases and in 1.9 per cent of the grand multiparas. In this small series, at least, the flaccid fibrous uterus of the pluriparous patient did not, as is usually stated, seem to influence the presentation.

*Accidental hemorrhage* did show a considerable increase, as was expected, with an incidence of 1.2 per cent in the general case group, as compared with 2.39 per cent in the grand multiparas.

*Placenta previa* occurred with approximately the same frequency, 0.4 per cent and 0.6 per cent.

*Postpartum hemorrhage* was the same for the two groups in our series, namely 0.6 per cent.

*Retained placenta* gave a ratio of 1.6 per cent for the general cases to 2.9 per cent for the grand multiparas—a definite increase ascribable to plurality.

*Morbidity:* Infection, unexpectedly, did not differ greatly in its frequency in the two groups, the figures being 2.4 per cent and 2.9 per cent for general cases and for the grand multiparas, respectively.

*Mortality rate:* At the three hospitals there were only nine deaths in 15,333 patients, giving the exceptionally low mortality rate of 0.06 per cent.

TABLE II. PERCENTAGE OCCURRENCE OF COMMON GENERAL COMPLICATIONS AMONG PREGNANT PATIENTS AND PERCENTAGE OCCURRENCE OF THESE COMPLICATIONS IN GRAND MULTIPARAS

	VICTORIA PRIVATE					VICTORIA STAFF					ST. JOSEPH'S COMBINED					CLEVELAND UNIV. HOSP.					GRAND TOTAL				
	TOTAL PATIENTS		GR. MULTIP.		% WITH COMP.	TOTAL PATIENTS		GR. MULTIP.		% WITH COMP.	TOTAL PATIENTS		GR. MULTIP.		% WITH COMP.	TOTAL PATIENTS		GR. MULTIP.		% WITH COMP.	TOTAL PATIENTS		GR. MULTIP.		% WITH COMP.
	NO.	%	NO.	%		NO.	%	NO.	%		NO.	%	NO.	%		NO.	%	NO.	%		NO.	%	NO.	%	
Obstetrical deliveries	3,795		79			792		107			5,993		210			4,753		106			15,333		502		
Cardiovascular disease	38	1.0	2	2.5		8	1.1	2	1.9		59	1.56	6	2.8		30	0.6	10	9.4		135	0.89	20	3.9	
Uterine fibroids	5	0.1	0	0		2	0.3	0	0		9	0.15	0	0		3	0.06	0	0		19	0.1	0	0	
Diabetes	11	0.29	0	0		1	0.1	0	0		5	0.08	1	0.4		5	0.11	0	0		22	0.15	1	1.9	

Of these nine deaths, two occurred in pluriparous patients, giving a percentage incidence of 0.39 per cent, a figure considerably higher than that for the general obstetrical patients. Both of these deaths in pluriparous patients were due to toxemia or hypertensive disease, one patient having had a long history of cardiovascular disease with hypertension.

*Late toxemias:* The toxemias which included pre-eclampsia, eclampsia, and acute yellow atrophy showed a considerably increased incidence in the grand multiparas, from a general percentage of 4.1 per cent to 11.1 per cent.



Fig. 1.—Change in family size is shown from 1920 to 1950, giving first, second, third, fourth, fifth, sixth and over children born in the United States per thousand native white women aged 15 to 44 years. The largest increase is in those families with one and two children only, but there has been a rise in those with three and a slow steady rise in those with four. The five-child family group just holds its own, while the larger ones slowly decline.

*Premature labors:* Premature labors occurred slightly more often in the grand multiparas but not as often as expected. Stillbirths and neonatal deaths were both more frequent. The figure for stillbirths was 1.5 per cent for the general cases, 3.0 per cent for the grand multiparas; the neonatal death rates were 1.2 per cent and 2.3 per cent, respectively.

*Twins* in our series showed a considerable increase, from 1.2 per cent to 2.39 per cent.

*Fetal abnormalities* occurred in a ratio of 1.02 per cent for the general group to 2.3 per cent in grand multiparas, a definite and considerable increase.

Operative procedures are included to suggest concisely the types of surgical work to be expected in the grand multipara as compared with the general obstetrical patient. Major forceps deliveries, which for purposes of this paper were taken to be any forceps delivery other than a low prophylactic outlet forceps, were 4.5 per cent for the general patient and 1.05 per cent for the grand multipara. Similarly, the cesarean section rate among these patients was 4.5 per cent for the general patient and 1.05 per cent for the grand multipara.

As was to be expected, the performance of episiotomies and the repair of lacerations were negligible, which conversely suggests that gynecological operations may have been in order for most of these patients for vaginal and structural laxities. The ratios found were 52 per cent episiotomies to 0.03 per cent episiotomies in the grand multiparas and 9.0 per cent lacerations repaired to 0.03 per cent for the pluriparous patient. Therefore, despite the increased age of the multiparous patient and the expected handicaps attendant upon multiparity, operative procedures were greatly decreased in this group.

### Medical Complications

It was recognized that general physiological conditions and the systemic diseases of aging were contributory causes of many of the complications, and of some of the deaths which ensued. Therefore, the next consideration was to obtain a comparison as to the relative importance of these factors in creating the complications.

The relative frequency of certain medical complications in the obstetrical patients and in the grand multiparas is shown in Table II. The total figures for the several hospitals are shown in the fifth group of columns and comment is based chiefly on these.

*Cardiovascular disease* was diagnosed in 0.89 per cent of all the patients but in grand multiparas cardiovascular disease was diagnosed in 3.9 per cent, a very significant increase.

*Diabetes* was slightly more prevalent in the grand multiparas, the general figures being 1.15 per cent for the general group and 1.9 per cent in grand multiparas.

*Uterine fibroids* were diagnosed in 0.1 per cent of the general obstetrical cases but were not diagnosed in any case of grand multiparity.

From a study of the preceding tables it is evident that for some conditions the pluriparous patient is confronted with an increased chance of difficulties. However, for certain other complications a slight decrease in the incidence of such dangers is shown. In other words, parity does not always adversely influence the outcome of pregnancy.



The further question arises as to what other factors besides parity are responsible for the changes in the incidence of the complications encountered.

The spacing of pregnancies, which it was not found practical to investigate in this paper, can be assumed to play an important role. For example, too frequent pregnancies are known to promote miscarriages and probably premature labors. Certainly, the increasing burden of home life and its responsibilities would be conducive to premature labors.

Beyond this, however, is the previously mentioned factor of increasing age and its effect upon the grand multipara. A survey of our cases established the fact that the approximate age of our grand multipara was 38 years—certainly relatively late in the childbearing era.

TABLE III. To Show: 1. THE PERCENTAGE OF CERTAIN COMPLICATIONS AT VARIOUS AGE GROUPS  
2. THE PERCENTAGE OF THESE COMPLICATIONS IN GRAND MULTIPARAS OF AVERAGE AGE 38  
3. COMPLICATIONS SHOWING AN INCREASE WITH AGE  
4. COMPLICATIONS SHOWING AN INCREASE WITH PARITY  
5. COMPLICATIONS FURTHER INCREASED BY PLURIPARITY

	% COMP. AGE UNDER 30		% COMP. AGE 30-35		% COMP. AGE 35 AND OVER		% COMP. GR. MULTIP. AV. AGE 38	COMP. IN- CREASED WITH AGE	COMP. IN- CREASED WITH MULTI- PARITY	COMP. FUR- THER IN- CREASED BY PLURI- PARITY
	PRIMIP.	MULTIP.	PRIMIP.	MULTIP.	PRIMIP.	MULTIP.				
Malpresentations										
Breech*	5.1	5.1	7.6	6.4	11.9	7.3	1.9	Yes	No	No
Hemorrhages										
Accidental*	0.5		0.7	1.5	1.4	2.4	2.39	Yes		No
Placenta previa*	0.4		1.4	1.9	0.9	3.5	0.6	Yes	Yes	No
Post partum	1.1		4.2	5.2	4.8	5.7	0.6	Yes	Yes	No
Retained placenta (manually re- moved)	0.99	1.4	1.6	1.3	2	2.6	2.9	Yes	Yes	Yes
Morbidity†	10	1.2	10	10	20	20	3	Yes		No
Mortality	0.03	1.6	0.04	0.08	1.8	1.8	0.4	Yes		No
Late toxemias	6.0	10	9.5	4.1	5.9	9.1	11.1	Yes	Yes	Yes
Premature labor	1.7	0.6	4.3	2.8	5.2	7.4	5.9	Yes	Yes	No
Stillbirths†	7.5	1.9	9		18		3.18	Yes	Yes	No
Neonatal deaths	1.3	1.5	1.7	2.6	4.9	3.1	3.0	Yes	Yes	No
Fetal abnormalities	0.8	0.8	1	1	2.8	2.0	2.4	Yes	Yes	No
Cardiovascular disease	0.3	0.8	0.7	0.8	3.4	4.0	3.9	Yes	Yes	No
Diabetes	0.07	0.02	0.08	0.19	0.08	0.16	1.9	Yes		Yes
Uterine fibroids	0.1	0.2	2.5	0.8	11.0	3.9	0	Yes	Yes	No
Cesarean section rate	1.3	2.2	8.7	3.6	9.3	5.4	1.05	Yes	No	No

The figures given of complications at the various ages were in part from our own investigation and in part from the excellent papers of Calkins and Dodge and Brown.

\*Calkins.

†Averaged from Dodge and Brown.

### Combined Effects of Age and Parity on the Incidence of Complications

In Table III there is shown the effect on the incidence of complications of age, as well as parity and increasing pluriparity.

*Malpresentation:* Breech deliveries were found to be markedly decreased in our grand multiparas, in comparison with the general cases of any age group but particularly with the elderly primiparous and multiparous patients. This finding is the opposite of the belief commonly held. One would hesitate to claim an advantage for the grand multipara, on the basis of this small series, but it is at least clear that she is confronted with no worse an outlook than her sister of comparable age in this respect.

*Accidental hemorrhage:* The occurrence of accidental hemorrhage seems to be associated with both increasing parity and increasing age. The incidence of this complication in the grand multipara is practically identical with that in any multipara of the same age but is definitely higher than in the elderly primipara of the same age. This increased incidence may be due to the presence of certain of the toxemias, nephritis, and hypertension in the older group and also the increase with advancing years of the myopathies.

*Placenta previa and postpartum hemorrhage:* Placenta previa, again unexpectedly, appeared less often in the grand multipara than in almost any other group and particularly less often than in the primipara and multipara of the same age.

This was generally also true of postpartum hemorrhage, an observation difficult to explain. In any group of patients postpartum hemorrhage might be expected to show an increase in direct relation to the age of the patient. In elderly primiparas associated cardiovascular problems may also be present and more difficult labors and deliveries are to be expected. Moreover, postpartum hemorrhage would be likely to increase with parity because of the failure of the more flaccid uterus to remain in a tonic state.

The fact that our figures do not show this indicates either that the group of cases is too small to give a true picture, perhaps, or that the patient who is able physically to become a grand multipara does not have such a degree of cardiovascular or other general physical impairment as some others of her age group. In other words, perhaps it is the fittest who survive to become grand multiparas.

*Retained placentas:* This complication was slightly more common in the pluriparous patient than in other patients. This factor seemed to be connected with age as well as with parity, however, as it occurred more frequently in all the older age groups and no more frequently in the grand multipara than in other multiparas of like age.

*Maternal morbidity:* This is difficult to evaluate although there seemed to be an increase as the age groups advanced, perhaps because of a general decrease in resistance. This was also suggested in the series of Dodge and Brown.<sup>2</sup>

*Mortality rate:* The mortality rate in our series did not lead to definite conclusions because of the small total of deaths that occurred. There were

three deaths reported in the 16 to 29 year age group which contained by far the greater number of deliveries, four in the 30 to 35 age group which contained fewer cases, and two in the 35 and over group which contained the smallest number of cases.

Of the deaths in our series, however, only one occurred in a grand multipara, giving a correspondingly lower percentage occurrence which did not substantiate the findings of Hellman and others that mortality rates definitely increase with parity alone.

*Toxemia:* A study of the table suggests immediately two important facts relative to the development of late toxemias of pregnancy. First, the occurrence of toxemia increases directly as age increases. Second, there was a greater incidence of toxemia among the grand multiparas than in the group of primiparas or multiparas of corresponding age.

These findings are similar to those of most investigators including Calkins,<sup>1</sup> Davis and Seski,<sup>8</sup> and Dodge and Brown,<sup>2</sup> who have made the statement that "Toxemias are more common in the very young and in the very old." The incidence of toxemia in our series was found to be lowest in the 16 to 29 year age groups. The very young ones were not investigated.

*Premature labor, stillbirths, and neonatal deaths:* Premature labor was found to occur more frequently in the older groups and also more often in the multipara than in the primipara. This might be expected in view of the increased incidence of cardiovascular disease, abruptio placentae, toxemias, myopathies, and placenta previa to be found in the older group. All may be accentuated in the multipara by increased work and responsibilities.

In the case of premature labors, there was a slightly lower rate in our findings for the grand multipara as compared with the other multipara of like age, but the figures are probably not statistically conclusive. It would be a happy finding if this lower rate could be attributed to older children relieving the home burden on the grand multipara.

*Fetal abnormalities:* Fetal abnormalities, as in other series, increased with age but did not seem to be influenced by parity.

*Systemic diseases and myopathies:* Perhaps it is here that is to be found the basic explanation of the increasing number of complications as age advances. Hypertensive and renal-vascular disease is a manifestation of aging. Pregnancy influences these conditions adversely. In the multipara, each pregnancy may add to the residual damage so that successive childbearing may be particularly hazardous to the woman who has reached middle life. Most of the complications of the older pregnant women are thus not obstetrical in origin but are due to pre-existing systemic disease, largely cardiovascular in type.

To a lesser extent this point may be made for such diseases as diabetes and such conditions as fibromyomas. Fibromyomas increase with age but are a minimal source of complication in the grand multipara. Her more predisposed sister has developed her tumors before she could attain this classification of grand multipara.

Therefore, although parity is a deciding factor for a few obstetrical complications, in many cases it is merely secondary to a pre-existing systemic condition prevalent among all women in the older age groups.

This paper has not attempted to explore the economic or social pressures which confront the grand multipara, the discomforts and trials of pregnancy and motherhood, or the resulting gynecological complications of extreme parity, but only the complications which may occur from the new pregnancy itself.

With careful clinical investigation, preferably conducted before a new pregnancy, a real degree of protection could be afforded to the potential grand multipara and a more definite answer given to her question, "What will another pregnancy do to me?"

### Conclusions

1. Increasing age of obstetrical patients produces increased hazards.
2. When accompanied by pre-existing systemic disease, largely cardiovascular-renal in origin, the dangers are markedly increased to mother and child.
3. Pluriparity creates directly only a minority of obstetrical complications but produces an adverse influence on the older patient with pre-existing systemic disease.

I wish to express my appreciation to the Staff of the University Hospitals of Cleveland, Ohio, for their help and courtesy in allowing me access to their records.

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## **THE END RESULTS IN CHILDREN DELIVERED BY MID OR HIGH FORCEPS\***

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**T**HE purpose of this project was to determine whether the use of high or midforceps in the delivery of a specific group of babies had in any way impaired the subsequent physical or mental development of these individuals.

The survey was made possible by a grant from the Federal Department of Health and Welfare, through the Department of Health of Nova Scotia.

### **Method of Selection**

In all, 430 medium and high forceps deliveries were culled from the total number of birth records (4,641) which took place at the Grace Maternity Hospital, Halifax, from 1922 to 1936, inclusive. Five hundred control cases of spontaneous deliveries were chosen from the same over-all total number of cases, using Snedecor's table of random numbers as the method of selection.

Due to obvious difficulties in tracing these individuals after seventeen to thirty-one years which had elapsed since their birth, in spite of much energetic and ingenious searching, only 159 controls and 145 forceps cases were located. At the conclusion of the survey only 90 individuals of the instrument group and 76 of the controls had kept their appointments to be examined. Of this number two individuals failed to complete one of the tests—a mental defective in the high forceps group and an un-cooperative subject in the control group.

### **Methods of Examination of the Individuals Concerned**

Each subject was submitted to a full physical examination, with particular emphasis on the neurological system, by Dr. Arthur Elliot, a resident internist. Likewise, each individual was examined by a psychologist—Mr. Kenneth Nickerson, formerly, and Mr. Hugh Vincent, latterly.

Of the 166 individuals examined, Dr. Elliot found only 7 who had any physical disability and, of these, 2 were in the control group. The disabilities noted were sluggish reflexes in 4 and strabismus in 3 persons.

### **Explanation of the Methods of Psychological Testing**

It was decided to use two tests, viz., the Wechsler-Bellevue Intelligence Scale and the Bell Adjustment Inventory. The former is an intelligence test. It is used to place an individual on a relative basis to the rest of the population in so far as intelligence is concerned. A person with an intelligence quotient between ninety and one hundred ten is said to be of "normal" intelligence. Statistically 50 per cent of the population would fall within this range.

\*Read at the Ninth Annual Meeting of the Society of Obstetricians and Gynaecologists of Canada, Wellesley Island, N. Y., June 5 to 7, 1953.

The complete test consists of eleven subtests, but, because a short interview was essential, only four were used. This short form consists of the Vocabulary, Information, Block Design, and Similarities subtests. The resulting scores were then prorated and an I.Q. was given to each subject.

Of the individual subtests on this scale, Block Design has long been considered the most valid indication of organic pathology. Thus, if an individual were to obtain weighted scores in the vicinity of thirteen on the majority of the other subtests and dropped to a score of three on Block Design, brain damage would be suspected. That is why, in our survey population, not only were I.Q.'s compared, but also the scores on Block Design. We hoped that by comparing mean weighted scores of this subtest, we could find indication of brain damage resulting from birth trauma if any such damage existed.

TABLE I. WECHSLER-BELLEVUE INTELLIGENCE TEST FORM I  
Standard Short Form—Vocabulary, Blocks, Information, Similarities

GROUP	COMPLETE GROUPS			MEN			WOMEN		
	NO.	MEAN I.Q.	BLOCK DESIGN MEAN WEIGHTED SCORE	NO.	MEAN I.Q.	BLOCK DESIGN MEAN WEIGHTED SCORE	NO.	MEAN I.Q.	BLOCK DESIGN MEAN WEIGHTED SCORE
High forceps	17	118	11.1	7	109	9.9	10	124	11.9
Medium forceps	73	124	12.3	37	126	12.7	36	122	12.0
Total instrument cases	90	123	12.1	44	124	12.2	46	122	11.9
Controls (natural)	76	115	11.1	26	121	11.9	50	112	10.6

*The Second Test.*—The Bell Adjustment Inventory consists of a series of questions concerning an individual's adjustment in a variety of areas—home, health, social, emotional, and occupational. Thus if a person obtained a score of one on Home Adjustment, we would say he was excellently adjusted, while another might obtain a score of sixteen or more and we would say that that person's adjustment in that area was very unsatisfactory.

It will be noted that in all cases the instrument groups showed not only higher I.Q. but also higher Block Design scores.

When the differences had been statistically evaluated, the following results were found. The total instrument cases showed a higher I.Q. than did the total number of control cases and this difference was significant at the 1 per cent level. The score on Block Design was also higher for the total instrument group and this was significant between the 5 and 1 per cent level.

After these total groups had been compared each group was broken down into male and female groups and compared again. *There were no significant differences in the male group* in either intelligence or Block Design scores.

In the female group when the instrument group was compared with the control group, the deviation in intelligence was found to be significant at the 1 per cent level. Likewise, the difference in Block Design scores was significant between the 5 and 1 per cent levels.

TABLE II. RESULTS OF SIGNIFICANCE TESTS

	GROUPS COMPARED	t SCORE	
		I.Q. DIFFERENCE	BLOCK DIFFERENCES
<i>Total.</i> —	Instrument vs. control	3.06 Sig. P < .01	2.40 Sig. P .05 to .01
	High forceps vs. control	0.64	
	Med. forceps vs. control	3.41 Sig. P < .01	2.78 Sig. P < .01
<i>Males.</i> —	Instrument vs. control	0.76	1.74
	High forceps vs. control	1.54	1.61
	Med. forceps vs. control	1.44	0.91
<i>Females.</i> —	Instrument vs. control	2.88 Sig. P < .01	2.48 Sig. P .05 to .01
	High forceps vs. control	2.07 Sig. P .05 to .01	1.56
	Med. forceps vs. control	2.68 Sig. P < .01	2.46 Sig. P .05 to .01

TABLE III. THE BELL ADJUSTMENT INVENTORY

	SEX	NO.	MEAN HOME ADJUST- MENT	MEAN HEALTH ADJUST- MENT	MEAN SOCIAL ADJUST- MENT	MEAN EMOTIONAL ADJUST- MENT	MEAN OCCUPA- TIONAL ADJUST- MENT
<i>High For- ceps.</i> —	Men	6	2 (Good)	3 (Good)	9 (Average)	2 (Good)	2 (Good)
	Women	10	4 (Average)	4 (Good)	9 (Average)	9 (Average)	2 (Good)
<i>Medium Forceps.</i> —	Men	37	5 (Average)	4 (Average)	11 (Average)	6 (Average)	5 (Average)
	Women	36	4 (Average)	4 (Good)	13 (Average)	9 (Average)	5 (Average)
<i>Controls.</i> —	Men	26	4 (Average)	4 (Average)	12 (Average)	7 (Average)	6 (Average)
	Women	49	4 (Average)	5 (Average)	13 (Average)	10 (Average)	4 (Good)

TABLE IV. PERCENTAGE DISTRIBUTION OF BELL ADJUSTMENT SCORES

	ADJUSTMENT	MEN			WOMEN		
		HIGH	MEDIUM	CONTROL	HIGH	MEDIUM	CONTROL
<i>Home.</i> —	Excellent	50	38	35	20	31	41
	Good	40	14	35	40	28	20
	Average	10	32	23	40	33	33
	Unsatisfactory	—	14	7	—	6	2
	Very unsatisfactory	—	2	—	—	2	4
<i>Health.</i> —	Excellent	33	27	12	30	11	22
	Good	33	27	46	50	47	29
	Average	33	39	35	10	31	31
	Unsatisfactory	—	6	7	10	11	16
	Very unsatisfactory	—	2	—	—	—	2
<i>Social.</i> —	Very aggressive	—	8	12	10	11	10
	Aggressive	33	22	27	40	14	16
	Average	66	51	38	50	58	55
	Retiring	—	5	8	—	14	14
	Very retiring	—	14	15	—	3	4
<i>Emotional.</i> —	Excellent	67	27	15	—	19	6
	Good	16	16	15	20	19	14
	Average	16	38	53	70	39	63
	Unsatisfactory	—	11	12	10	17	10
	Very unsatisfactory	—	8	5	—	6	6
<i>Occupational.</i> —	Excellent	60	33	25	60	25	26
	Good	20	29	31	40	38	37
	Average	20	25	38	—	38	37
	Unsatisfactory	—	—	6	—	—	—
	Very unsatisfactory	—	13	—	—	—	—

Women delivered by high forceps compared with the controls showed a difference between the 5 and 1 per cent level. Women delivered by medium forceps compared with the control group showed a higher I.Q. which was significant at the 1 per cent level, while the Block Design score showed a significance between the 5 and 1 per cent level.

In comparing the results from the Bell Adjustment Inventory the groups were divided into male and female and high forceps, medium forceps, and controls were compared.

In Table IV is shown the percentage of each group which fell into the various categories of adjustment in each of the five adjustment areas.

Finally the percentage distribution of intelligence quotients is seen in Fig. 1.

**PERCENTAGE DISTRIBUTION OF INTELLIGENCE QUOTIENTS**

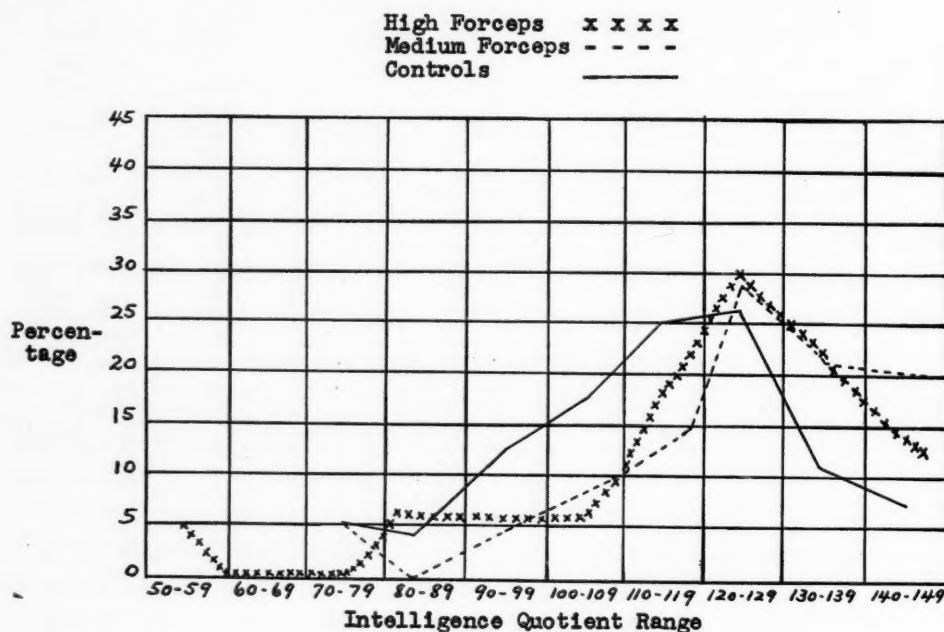


Fig. 1.

In the total number of spontaneous deliveries (viz., 3,711) which occurred during the years 1922-1936, inclusive, the stillbirth rate was 5.65 per cent and the neonatal death rate was 2.8 per cent (Table V).

TABLE V. COMPARISON OF STILLBIRTH RATES AND NEONATAL DEATH RATES IN ALL GROUPS

	TOTAL	STILLBIRTH	NEONATAL
Spontaneous deliveries	3,711	5.65%	2.8%
High forceps	107	27.0%	10.0%
Midforceps	323	8.3%	5.8%

In the total number of forceps deliveries (high, medium, and low) (viz., 930), the total infant mortality was 9.2 per cent and of these the high forceps (107) showed a stillbirth rate of 27 per cent and a neonatal mortality of 10 per cent.



The midforceps deliveries (323) had a stillbirth rate of 8.3 per cent and a neonatal death rate of 5.8 per cent.

### Conclusions

This study was commenced with a preconceived idea that forceps deliveries in some instances caused permanent injury to the baby so delivered; also that such babies often developed epilepsy in later life. From the results shown here it can be seen that this is not the case as regards physical and mental development and also let it be said that not one case of epilepsy was discovered in this series of cases.

Therefore, from the results obtained in this study it would appear that if a baby *survives* a mid- or high forceps delivery then no physical or mental impairment is to be expected.

I hereby wish to acknowledge the invaluable help given by Miss Jean Peabody, Dalhousie University Statistician, in the compilation of the statistical tables and to thank Mr. Hugh Vincent for the psychological report on the project.

## THE TRAINED OBSTETRICAL PATIENT\*

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CONSIDERABLE comment, both favorable and unfavorable, has been voiced in the last few years concerning the increasing popularity of the so-called natural childbirth regime introduced by Grantly Dick Read<sup>1</sup> and Helen Heardman<sup>2</sup> in England. The reports from the Maternity Center Association of New York, and from Thoms' Yale Clinic, and the widespread publicity accorded in the lay press have multiplied inquiries from expectant mothers, and have forced doctors to acquaint themselves with the principles and practices of this so-called natural childbirth.

Dr. Thoms'<sup>3</sup> monograph quotes Dr. F. J. Browne, Professor of Obstetrics at the University of London, as saying: "Nothing has been more remarkable in the practice of obstetrics within the last ten years, than the increased appreciation of the value of principles enunciated by Edmund Jacobson<sup>[4]</sup> in 1929 in his book, *Progressive Relaxation*, and afterward applied to midwifery by Grantly Dick Read in his two books, *Natural Childbirth and Revelations of Childbirth*."

During the course of postgraduate study in Chicago, I was able to observe some of the benefits which accrued to patients who took part in a planned program along the lines laid down by Read and Heardman, and it was this experience which prompted me to institute a program of training for my private patients. The report which follows concerns 222 private patients who voluntarily took part in a training program for childbearing.

The term "natural childbirth" is an unfortunate one, since it implies that labor is painless in primitive peoples. Clellan Ford<sup>5</sup> in his *Comparative Study of Reproduction* concluded: "The popular impression of childbirth in primitive society as painless and easy is definitely contradicted by our cases. As a matter of fact it is often both prolonged and painful."

The uninformed woman is often under the erroneous impression that "natural childbirth" implies an attempt to resort to a primitive regime devoid of analgesic or anesthetic aids in labor. Because we have felt that this denial of analgesia and anesthesia is not an important or integral part of the program, we have adopted Thoms' suggestion, and speak to our patients of a training program in preparation for childbearing. We have studiously avoided the term "natural childbirth," and have carefully warned all patients that this is not a program of painless labor.

\*Read at the Ninth Annual Meeting of the Society of Obstetricians and Gynaecologists of Canada, Wellesley Island, N. Y., June 5 to 7, 1953.

The principles of such a training program are undoubtedly familiar to all obstetricians so that nothing but the briefest outline of the program is offered. It consists of:

1. Education, designed to acquaint the patient with the emotional as well as the physiologic aspects of pregnancy and labor.
2. Physiotherapy, which includes lessons in relaxation, muscle exercises, posture, and informative talks about labor and delivery, so that patients come into the hospital with a fairly clear picture of the processes involved and know what to expect. It has been found that this portion of the program is best carried out in groups, from the viewpoint of both patient interest and economy of operation.
3. Increased supervision in labor. By this is meant that the patients are not left alone in labor but are given support and encouragement by the nursing staff, occasionally by the physiotherapists who trained them, and by as frequent attendance of the obstetrician as is feasible.

The following report is an attempt to analyze statistically the results achieved in 222 trained patients. They are divided almost equally between primiparas and multiparas, 106 of the former, and 116 of the latter. So often one is impressed with the value of a method without being able to evaluate the results statistically. The figures to be presented are, therefore, given with the comment that the sense of well-being, the absence of psychic trauma, even in the few protracted and difficult labors, are intangibles not found in the case histories and not measurable in statistical tables. These patients have for the greater part been happy, interested patients during pregnancy and have behaved superbly in labor—this, as shall be shown, with a minimum amount of both analgesic and anesthetic agents.

The data to be presented are not particularly startling, and the results are probably not as good as those presented by Thoms, 50 per cent of whose patients received no anesthesia for delivery. We have made little attempt to deliver our patients without anesthesia since episiotomy has been a very common procedure and adequate repair of an episiotomy calls for some type of anesthesia.

TABLE I. DURATION OF LABOR IN PRIMIPAROUS AND MULTIPAROUS PATIENTS

DURATION OF LABOR IN HOURS	PRIMIPARAS		MULTIPARAS	
	NO.	%	NO.	%
Less than 6	15	13.2	59	50.8
Less than 12	40	37.7	35	30.1
Less than 16	20	18.8	17	14.6
Less than 18	8	7.5	1	0.8
Less than 24	17	16.0	4	3.4
Over 24	6	7.0	0	0

Duration of labor is difficult to establish since the onset of labor is so frequently indefinite. These figures are based on the statement of the patient on admission when she is asked when her labor started. About 70 per cent of primiparas had labors less than 16 hours in duration and 50 per cent had

labors 12 hours or less in length, a relatively short labor for first babies. The figures for multiparas are probably less significant since they have much shorter labors under any regime.

TABLE II. HOURS SPENT IN THE HOSPITAL BEFORE DELIVERY

HOURS IN HOSPITAL	PRIMIPARAS		MULTIPARAS	
	NO.	%	NO.	%
Less than 3	17	16.0	64	55.1
Less than 6	29	27.3	33	28.4
Less than 9	23	21.7	10	9.6
Less than 12	18	17.0	8	6.9
Less than 24	16	15.0	1	0.8
More than 24	3	2.8	0	0

The number of hours patients spend in the hospital before delivery (Table II) is of considerable importance from the point of view of both nursing hours and room accommodation, and these figures indicate that the trained patient stays home longer than her untrained sister because she is more comfortable and less likely to be driven to the hospital too early by her anxiety. Sixteen per cent of the primiparas and 55.1 per cent of the multiparas were admitted to the hospital less than 3 hours before delivery, and 43.3 per cent of the primiparas and 83.5 per cent of the multiparas spent less than 6 hours in the hospital before delivery.

TABLE III. SEDATIVES AND ANALGESICS EMPLOYED

ANALGESIA AND SEDATION	PRIMIPARAS		MULTIPARAS	
	NO.	%	NO.	%
None	24	22.6	87	75.0
Heroin, $\frac{1}{12}$ grain	22	20.8	12	10.3
Demerol, 100 mg.	35	33.0	16	13.7
Demerol, 100 mg. and Seconal	22	20.8	1	0.8
Heroin, $\frac{1}{12}$ grain and Demerol, 100 mg.	3	2.8	0	0

Table III is a summary of sedatives and analgesics administered. Twenty-two and six-tenths per cent of the primiparas required no drugs, while 53.8 per cent received a single dose of either heroin or Demerol. Twenty and eight-tenths per cent received  $1\frac{1}{2}$  to 3 grains of Seconal in addition to Demerol, and 2.8 per cent of the patients required Demerol, 100 mg., and heroin,  $\frac{1}{12}$  grain. The multiparas received much less—75 per cent required no analgesics, 24 per cent a single dose, and 1 patient received Seconal in addition to Demerol. It should be pointed out that the patients are generally instructed to ask for sedation when they want it and we have found this to be a much better guide to analgesia than any arbitrary regime. Frequently patients who have been given sedation have complained that it was given too soon, or that it made them less able to cooperate. This minimal sedation does not represent a policy of withholding sedation but is a true indicator of the needs of these patients for analgesia because it is given on demand.



Table IV shows the type of delivery in this group. Thirty-four and nine-tenths per cent of the primiparas and 73.2 per cent of the multiparas had spontaneous deliveries; 54.7 per cent of the primiparas and 21.5 per cent of the multiparas had outlet forceps deliveries. With reference to this rather large number of operative deliveries it should be pointed out that since many of these patients were delivered under pudendal block anesthesia, timing of the injection of the Novocain was a definite factor in a large number of perineal arrests. If the injection is made too early the patients lose the urge to bear down and are unable to push the head over the perineum. By more careful timing of the block we were able to deliver a larger proportion spontaneously during the latter part of the period reported.

TABLE IV. TYPES OF DELIVERY

TYPE OF DELIVERY*	PRIMIPARAS		MULTIPARAS	
	NO.	%	NO.	%
Spontaneous	37	34.9	85	73.2
Outlet forceps	58	54.7	25	21.5
Midforceps	8	7.5	5	4.3
Breech	3	2.8	1	0.8

\*Two cesarean sections for cephalopelvic disproportion are not included in these figures.

No apology is made for outlet forceps delivery in any case, since it is felt that in many instances the effort involved in perhaps 30 to 60 minutes of extra pushing in the second stage of labor after the head has reached the perineum is largely wasted and easy outlet forceps delivery is not a traumatic procedure. We aim at spontaneous delivery but we are not stubborn about it.

The midforceps deliveries were all for posterior positions, 8 of which ended in deep transverse arrest, and 5 were rotated from the posterior. There were 4 breech deliveries.

Two cesarean sections for cephalopelvic disproportion in trained patients have not been included in the figures.

TABLE V. TYPES OF ANESTHESIA EMPLOYED

ANESTHESIA	PRIMIPARAS		MULTIPARAS	
	NO.	%	NO.	%
Pudendal block	72	67.9	80	69.0
Pudendal block and Trilene	13	12.2	9	7.8
General	17	16.0	27	22.2
Spinal	4	3.7	0	0

Table V shows the type of anesthesia administered for delivery. Sixty-seven and nine-tenths per cent of the primiparas and 69 per cent of the multiparas had pudendal block alone for delivery; 80 per cent of the primiparas and 76 per cent of the multiparas were fully conscious at the time of delivery with 22 of the patients requiring intermittent Trilene during the terminal first stage. Sixteen per cent of the primiparas and 22.2 per cent of the multiparas preferred to be asleep for the delivery. Four primiparas were given low spinal anesthesia for difficult midforceps deliveries.

### Conclusions

While these figures do not make an incontestable case for a program of training in preparation for childbearing, they do suggest that labor may be shorter and less painful, since fewer analgesics and sedatives were needed without increasing patient discomfort. Pudendal block is undoubtedly a safe anesthetic. It permits the patient to be fully conscious at delivery if she so desires. We believe that active participation in the birth of her child has a beneficial emotional impact on the mother, and most patients have expressed amazement and delight at their participation in the exciting phenomenon of childbirth. Nurses are impressed with their behavior. They assert that it is easy to pick out the trained patient from her department during labor and delivery. As was stated earlier, the sense of well-being and the cooperation of these patients cannot be reduced to figures.

I doubt that what has been presented can be termed natural childbirth. During the prenatal training program no emphasis is placed on spontaneous delivery or delivery without anesthesia or analgesia. There is no question raised of success or failure. If patients succeed only in imperfect relaxation and prefer to be unconscious for their deliveries, we do not consider them to have failed. All that is promised is that benefit will accrue from the training. If they have succeeded in having easier, happier labors, with less anxiety and apprehension, then the extra time spent with these patients has been amply repaid.

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## THE USE OF CURARE-LIKE SUBSTANCES IN OBSTETRICS\*

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EVERY obstetrician has been confronted with a delivery in which he anticipates difficulty because of soft-tissue dystocia at the pelvic floor. In the past, spinal anesthesia has been used in such circumstances to produce relaxation of the pelvic floor and facilitate forceps extraction. It has not been ideal, however, from the viewpoint of the obstetrician, the patient, or the anesthetist. The obstetrician is dealing with a patient who is tired emotionally and physically and is not a suitable subject to be awake during a moderately difficult delivery. Many patients are reluctant to have a spinal anesthetic for various reasons. The anesthetists recently have displayed a disinclination to employ spinal anesthesia in any procedure. This disinclination has stemmed from a wider recognition of the dangers of spinal anesthesia, and the development of curare-like drugs which give equal relaxation with more adequate control and less serious complications.

With the increasing use of these curare-like drugs for surgical procedures, the question arose as to whether they could be used advantageously in routine forceps deliveries and particularly in the more difficult vaginal deliveries. After discussion with the anesthetic staff of the Toronto Western Hospital a trial series was begun on Aug. 1, 1952. The particular drug suggested by the anesthetic staff was Sincurine.† It was selected because of its short-acting property and the lack of side effects such as a fall in blood pressure and bronchospasm. In practice, an intravenous dose of 2 mg. has been found to produce a maximum relaxant effect in 3 to 4 minutes, without marked respiratory depression.

The customary practice for routine delivery has been to transfer the patient from the labor room to the delivery table when the caput is visible and there is beginning pressure upon the perineum. An inhalation anesthetic, cyclopropane or Trilene, is administered immediately by a qualified anesthetist. The patient is placed in the lithotomy position in stirrups, the genitals prepared, and the drapes arranged. Catheterization is carried out, and at this stage 2 mg. of Sincurine is given intravenously by the anesthetist. By the time the bladder is empty the relaxant effect of the drug is apparent in the perineum. An episiotomy is performed and the baby delivered by low forceps.

In the eight months following Aug. 1, 1952, 225 patients were delivered with the use of this routine. The observed results indicate that the use of curare-like drugs is a worth-while adjunct in vaginal delivery.

\*Read at the Ninth Annual Meeting of the Society of Obstetricians and Gynaecologists of Canada, Wellesley Island, N. Y., June 5 to 7, 1953.

†Sincurine is bistrimethylammonium decane dibromide (Burroughs Wellcome & Co., Inc.).

First, there has not been one apparent instance in which the baby has been affected in any way. This opinion has been confirmed by other reports that these drugs do not cross the placenta.

Second, the forceps deliveries have been noticeably easier because of the marked relaxation of the pelvic floor.

Third, because of the marked relaxation, a small episiotomy has been possible and a midline episiotomy feasible more often. This has resulted in reduction of the episiotomy repair time from an average of 17 minutes to 12 minutes.

Fourth, because of the relaxation a lighter plane of anesthesia has been possible and this fact, with the shorter episiotomy repair time, has resulted in a shorter, lighter anesthetic. There has consequently been less nausea and less respiratory tract irritation. Because of the need for less of the anesthetic agent, Trilene has been found to be adequate in most instances, although sometimes supplemental nitrous oxide or cyclopropane is required if there has been little sedation. The advantage of having the patient awake, without nausea, almost at the conclusion of the episiotomy repair has been obvious.

Last, in no instance has the anesthetist encountered any difficulty with the use of Syncurine. There is usually an immediate, noticeable change in the respiratory rhythm as the intercostal muscles are affected but this has never caused concern.

Occasionally when the delivery has taken a longer time the drug has been repeated in 6 to 7 minutes. In none of these instances has difficulty been encountered with baby or mother.

It is recognized that these drugs are potentially dangerous and should be used only by an experienced anesthetist, with facilities for controlled artificial respiration at hand. From the results in this series it is felt that the curare-like drugs represent another of the minor advances in medicine which every day are contributing to the safety and comfort of the mother, and the safety of the baby.

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## A SURGICAL APPROACH TO THE TREATMENT OF MITRAL STENOSIS IN PREGNANCY\*

### A Preliminary Report

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THIS preliminary report is based on a study of seven pregnant patients included in a series of commissurotomy operations for mitral stenosis, just about to be published by Dr. W. G. Bigelow, Dr. W. F. Greenwood, and others<sup>1</sup> from the Departments of Surgery and Medicine at the University of Toronto. The material has been collected by the Medical Staff of the Toronto General Hospital, including the Wellesley Division. All patients have been examined and followed by Dr. Greenwood and his collaborators and all operations have been done by Dr. Bigelow himself. The seven obstetrical patients in this series all have been seen prior to operation by a member of the Obstetrical Staff who has followed them through their pregnancy and deliveries whenever this has been possible. The series is small and the data are incomplete but it is felt important enough to draw to your attention a new trend in our thinking with regard to mitral stenosis in pregnancy.

Pregnancy is a major complication of mitral stenosis. In the United States, heart disease is the fourth highest cause of maternal death,<sup>2</sup> exceeded only by hemorrhage, infection, and toxemia. Mitral stenosis, either alone or associated with insufficiency, is by far the commonest lesion found. Burton E. Hamilton,<sup>3</sup> of the Boston Lying-in Hospital, in 76,125 pregnancies found 1,335 cases of heart disease, or 1.8 per cent; 93 per cent of these were rheumatic heart disease.

It has been common practice among obstetricians in the past to allow a patient with mitral stenosis one pregnancy if there has been no failure, then seriously to consider sterilization; if there has been a history of failure, to terminate the pregnancy and then advise sterilization. In fact, Eastman in his textbook says, "We are most reluctant to allow pregnancy to continue in cardiac patients with auricular fibrillation or *with a history of past failure.*"

Hamilton<sup>3</sup> divided his cardiac patients into favorable and unfavorable candidates for pregnancy, a favorable patient being a woman with minimal signs of rheumatic heart disease who is able to carry on moderate activity without having heart failure and who has no complicating condition which, in itself, is dangerous, e.g., hypertension, chronic bronchitis, diabetes, etc.

\*Read at the Ninth Annual Meeting of the Society of Obstetricians and Gynaecologists of Canada, Wellesley Island, N. Y., June 5 to 7, 1953.

Table I shows his mortality rates in pregnant and nonpregnant women for a year of living. He concludes, "A pregnancy, then, has cost the favorable cases little, if any, more risk than their risk of death in one year of living, but it has cost the unfavorable cases a risk nearly three times greater, and those that have auricular fibrillation, a risk that is four times greater."

TABLE I. COMPARATIVE MORTALITY RATES IN RHEUMATIC HEART DISEASE

	PREGNANT	NONPREGNANT
Favorable	2.0%	2.0%
Unfavorable	18.0%	6.7%
Auricular fibrillation	32.0%	8.0%

Mortality rate for normal women in a similar age group, 0.45 per cent per year.

More recently a few articles have been published, including a large series from the Margaret Hague Hospital,<sup>4</sup> showing that with bed rest, restricted salt intake, and careful treatment in hospital, it is possible to carry even a patient with serious heart disease through pregnancy and labor with safety and the prospect of a little improvement after delivery. It would seem that pregnancy is a dangerous episode in the life of a patient with mitral stenosis but, once survived, it has little effect on the progress of the disease.

There are those that will ask why, if this be true, should one consider subjecting such a patient to commissurotomy. An attempt was made, therefore, to see what happened to these patients who had suffered failure during pregnancy and who seemed to do well afterward.

Between 1937 and 1941 at the Toronto General Hospital,<sup>5</sup> there were sixteen cases where pregnancy precipitated severe pulmonary congestion. These patients have been followed until the present time, a period of ten to fifteen years, and this is how they stand at present—Six are dead (average life  $6\frac{1}{3}$  years after precipitating attack), four are medically disabled after an average of twelve years, and there are six with slight or no symptoms (average  $14\frac{1}{3}$  years later). We, of course, cannot say what a similar period will show in patients who have had commissurotomy but the record is not so good that it should discourage us from trying any new method which holds out some hope.

The conservative method of treatment requires ideal conditions for the patient. Long periods of hospitalization, adequate help in the home, and proper supervision of the rest of the family are necessary. This presents a social and economic problem quite beyond the means of many families. In the postnatal period, the mother returns to added work with at least the same handicaps she had before. She will have to face a harder life with no greater reserve.

To the present time, then, the treatment of heart disease in pregnancy, though undoubtedly improved in the last ten or fifteen years, has been discouraging and the outlook for the young cardiac patient who desires a family has been far from hopeful, especially if her disease was even slightly advanced.

In March of 1950, two of us<sup>1</sup> at the Toronto General Hospital started a series of commissurotomy operations and are now publishing our results in the first sixty-five. The first thirty-five have been followed from six months to

three years. The latter half of this series includes five of the seven cases of heart disease complicated by pregnancy which are being reported today. The first case of pregnancy was No. 13 in this series.

After a study of the excellent results in the early cases and in others reported in nonpregnant patients, we were convinced that pregnancy with its increasing load on the heart called for serious consideration of this operation. We were also convinced that the operation did not involve too great a risk to be accepted.

*Selection of Cases.*—In the selection of cases for commissurotomy, it was felt that, if certain conditions were complied with, the case would be ideal and could be operated on with little risk and a good chance of remarkable improvement.

These conditions were:

1. Clinical proof of mitral stenosis.
2. A definite disability due to pulmonary congestion. This should be quite marked or it should have progressed in the two years prior to operation. This disability manifests itself in one or more of the following ways: (a) marked shortness of breath on exertion, usually one flight of stairs or one block on the level at an ordinary rate; (b) attacks of pulmonary edema (Two patients have died of acute pulmonary edema while awaiting operation. Thus, it is felt that one attack of acute pulmonary edema in a patient with mitral stenosis is sufficient disability to warrant taking the risk of operation.); (c) repeated hemoptysis, especially if massive.
3. Absence of other important diseases of the heart, e.g., mitral regurgitation, aortic valvular disease, or active rheumatic myocarditis.
4. Absence of chronic failure of the right side of the heart.

In the larger series, these rules have not always been adhered to as the authors have been feeling their way and trying with increasing experience to enlarge the group of patients that can be helped. This is illustrated by Case 6 in our group, whose first sign of heart disease was a sudden cerebral embolus when she was two and one-half months pregnant. She had aortic insufficiency as well as mitral stenosis but was operated on with the hope of preventing further emboli. One of us (W. G. B.) is convinced that removing auricular clots and amputating the auricular appendage together with the relief of stagnation in the auricle cuts down, very considerably, the danger of further embolic catastrophes. The other six cases fulfilled the above requirements. They were candidates for commissurotomy on the basis of their heart disease, and the pregnancies would most certainly have been terminated prior to the advent of this operation with the full approval of both the obstetrical and medical staffs.

The first patient was 30 years of age. This was her fourth pregnancy (one spontaneous abortion). She had had failure on and off for five years. It occurred during her last pregnancy and she had hemoptysis on several occasions between the last two pregnancies. She presented herself at about seven weeks and was already beginning to have shortness of breath. It was debated whether

the optimum time for operation was then or at three and one-half months. On the basis of her heart disease, it was decided to go ahead at once and give her the maximum time to recover. This was done, the end result being very satisfactory.

TABLE II. DATA ON THE CARDIAC STATUS OF THE PATIENT

CASE	AGE	TIME SINCE FIRST ATTACK	PREOPERATIVE CLASSIFICATION NEW YORK HEART ASSOCIATION
1	30	5 years	IV
2	37	Since childhood	IV
3	28	1 year	III
4	31	8 years	IV
5	26	1½ years	III
6	33	6 months (hemiplegia)	II
7	23	14 months	III

#### *Length of Gestation.—*

At first there was concern as to the proper time during pregnancy to do these operations. It is now felt that, within certain limits, this may be selected entirely on the basis of the heart. Most patients have had to be operated on as soon as possible after they presented themselves. This has now been done in the second, third, fourth, and fifth months, and in no case has there been the slightest hint of threatened abortion. The operation does not seem to be a shocking one. The only significant fall in blood pressure, a very transient one, occurs when the operator is occluding the mitral valve with his finger tip. The tendency now is to operate early in pregnancy in order to give the heart its best chance to recover before the maximum load of pregnancy is reached.

#### *Preoperative Care.—*

No specific preoperative care has been carried out in the pregnant patients. An attempt has been made to have them in as good medical condition as possible and to be sure that there is no active rheumatic fever or intercurrent infection.

#### *Postoperative Course.—*

Anticogulants were not used during the operation or following it in either series after the first few cases, unless an embolic phenomenon occurred.

All pregnant patients have stood the operation well. Six out of seven have had to have their chests aspirated a day or two later, from 200 to 600 c.c. of blood being removed. One had a pulmonary embolus on the twelfth day, was treated with Dicumarol, and recovered without further incident.

They were all kept in oxygen up to forty-eight hours and all allowed up on the third or fourth day and home in two or three weeks. It was surprising how soon these patients volunteered that their symptoms had been relieved, the tightness had gone from their chests, and they could now breathe more easily. Often, for the first time in months, they could sleep lying flat. Their exercise tolerance increased dramatically from the day they were allowed out of bed and, when seen a month after discharge, they were doing many of their household duties.



*Mortality.*—

There have been no deaths in the pregnant patients. In the sixty-five cases reported,<sup>1</sup> there have been six, two of which occurred in the first three cases. There have been no deaths in the last twenty-two cases. All deaths have occurred in the first postoperative week.

TABLE III. DATA ON SURGICAL PROCEDURE

CASE	DATE OF OPERATION	MONTH OF PREGNANCY	IMMEDIATE POST-OPERATIVE COURSE	DAYS IN HOSPITAL
1	Feb. 25/52	2	Hemothorax 300 c.c. Pulmonary embolus, twelfth day	29
2	April 28/52	4	Hemothorax 400 c.c.	22
3	Nov. 20/52	3	Hemothorax 250 c.c.	20
4	Feb. 7/53	4	Hemothorax 350 c.c.	21
5	Feb. 27/53	3½	Uncomplicated	27
6	March 4/53	3	Hemothorax 200 c.c.	36
7	March 18/53	5	Hemothorax 600 c.c.	20

The subsequent obstetrical history, as far as it has been possible to show it, is given in Table IV.

TABLE IV. OBSTETRICS STATUS AT TIME OF OPERATION AND SUBSEQUENT COURSE

CASE	GRAVIDITY	PARI-TY	MONTH OF PREGNANCY	PRENATAL CARE	DATE OF CONFINEMENT	LABOR AND DELIVERY	PUERPERIUM
1	iv	iii	2	Continued improvement	Sept. 25/52	7 hours normal	Normal
2	iii	iii	4	Continued improvement	Sept. 11/52	4 hours normal	Pulmonary embolus, 10 days Normal
3	ii	ii	3	Continued improvement	May 9/53	4 hours normal	Normal
4	ii		4	Continued improvement			
5	iii		2½	Continued improvement			
6	iii	ii	3	Continued improvement			
7	ii	i	5	Continued improvement			

*Present Status (Table V).*—

Five out of seven patients have been given Grade A rating by the cardiologist, which means that they are asymptomatic and are able to carry on normal life. They do their ordinary housework and enjoy normal social activities, receiving no treatment.

TABLE V. PRESENT CARDIAC STATUS OF PATIENTS

CASE	DATE LAST HEARD FROM	RATING BY CARDIOLOGIST
1	May 4	A
2	April 25	B
3	May 30	A
4	May 30	A
5	May 4	A
6	May 20	B
7	May 30	A

Case 6 still has hemiplegia, though she is improved as far as her heart is concerned, and Case 2 only fails to fall into Grade A because of fibrillation. She is very much improved, looks after her baby, and does all her own housework.

### Comment

This, as already stated, is only a preliminary report. The series, as yet, is extremely small and the obstetrical data are incomplete. We have been fortunate in having no deaths, since even one would very adversely affect the mortality rate. The effect of the complications of pregnancy, such as toxemia and hemorrhage, is still unknown. We have had no long or difficult labors up to the present.

It appears that pregnant patients with mitral stenosis and a history of failure, when carefully selected, stand the operation well, show remarkable improvement in their exercise tolerance, and are able to lead a pretty normal life throughout the rest of pregnancy. The three patients delivered had normal labors, the puerperium in two was uneventful. The third had a pulmonary embolus on the tenth day, which probably was unrelated to her heart.

A careful assessment of the present physical condition of the other four leads us to expect the same good result. Time alone will tell.

We have, then, a group of seven patients with mitral stenosis, complicated by pregnancy, six of whom had had attacks of congestive failure before the present pregnancy, and one who had had a hemiplegia from a cerebral embolus, due to mitral stenosis. These patients all had commissurotomies done during this present pregnancy. All are alive and very much improved.

With all its obvious shortcomings, this study is encouraging. It gives us grounds for hoping that, as experience with this operation increases, more and more young women with mitral stenosis will be able to bear children safely. Commissurotomy now has an important place in the treatment of this disease, and, with its more frequent use, the indications for therapeutic abortion and sterilization will be narrowed to a very small group indeed.

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**PREGNANCY AND DELIVERY FOLLOWING BILATERAL  
URETEROSIGMOID TRANSPLANT FOR EXSTROPHY  
OF THE BLADDER\***

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**E**XSTROPHY of the bladder is a rare congenital anomaly found only in the human species.<sup>1</sup> Approximately one baby in 50,000 is born with this condition, and it is reported to be about five times as frequent in males as in females.<sup>2, 3</sup> Cases in adults are rare, as 50 per cent of untreated children die before the age of 10, usually from renal sepsis or failure, and only one-third survive to the age of 20.<sup>4</sup> Therefore, pregnancy complicated by this condition is extremely unusual.

The condition is characterized by the absence of the anterior wall of the bladder, and the corresponding portion of the anterior abdominal wall. Thus the inner surface of the posterior bladder wall is everted, and protrudes on the abdomen. The pubic symphysis is absent, and the pubic rami are widely separated. Insertion of the rectus muscles into these separated rami produces a triangular defect in the lower abdominal wall. The perineum is shifted forward, so that the vaginal introitus lies between the pubic rami, and the anus opens more anteriorly than usual. In the female the urethra is absent, or represented by a shallow sulcus. The clitoris is cleft, or absent. The labia may be incompletely developed, and are widely separated anteriorly. The vagina is short, and the cervix often protrudes.<sup>5, 6, 7</sup>

Ectopia vesicae is believed to be due to a mesodermal deficiency, particularly of the process of secondary mesoderm, arising from the posterior end of the primitive streak.<sup>1, 5, 8-12</sup> Many other congenital malformations are frequently associated. Uterine and vaginal abnormalities may be present, but these women usually retain their power of reproduction.

Treatment of exstrophy of the bladder is ureterosigmoid transplant, in either one or two stages, followed by removal of the bladder, and plastic repair of the anterior abdominal wall. This operation is tolerated well by infants, and the trend today is to early transplant, with plastic repair at a later date.<sup>3, 4, 8, 13, 14</sup> Improved surgery, the use of antibiotics, and the better selection of cases have reduced the operative mortality almost to zero. Intravenous pyelograms show that, with good operative technique, the kidneys and ureters remain normal, or fairly normal, for years. Thus those who survive a successful transplant can expect to live indefinitely in good health.<sup>3, 13, 15</sup>

Bonnet in 1722 reported the first delivery in a case of exstrophy of the bladder. In 1918, Miller and King,<sup>16</sup> found 13 cases in a review of the litera-

\*Read at the Ninth Annual Meeting of the Society of Obstetricians and Gynaecologists of Canada, Wellesley Island, N. Y., June 5 to 7, 1953.

ture, and added one of their own. The articles published since that time are summarized in Table I.<sup>7, 15-23</sup> To date, 37 cases of pregnancy complicating extrophy of the bladder have been recorded in the literature of the English-speaking world.

These 37 women have been delivered of 49 children. There were 38 vaginal deliveries, including one set of twins, and 10 cesarean sections. Forty-one children were born alive. None had congenital abnormalities.

TABLE I. SUMMARY OF CASES REPORTED IN THE LITERATURE OF PREGNANCY COMPLICATING EXTROPHY OF THE BLADDER

AUTHOR	YEAR	DESCRIPTION OF ARTICLE	NO. OF CASES	DELIVERIES						
				NO.	VAGINAL	CESAREAN SECTION	CHILDREN	STILLBIRTHS		
Miller and King <sup>16</sup>	1918	Review of literature 1 case	14	18	18		18	5	8	
Sage <sup>17</sup>	1924	1 case	1	1		1	1			
			15	19	18	1	19	5	8	Without ureteral transplant
Eberbach and Pierce <sup>18</sup>	1928	1 case Review of literature Green Armytage, Mayo, Knauf 1 case	19	23	20	3	24	5	8	1 set of twins 3 cases from Mayo Clinic 1 case with sterilization after cesarean section
Randall and Hardwick <sup>19</sup>	1934	Review of: 1. Mayo Clinic cases 1912-32 2. Literature	20	28	23	5	29	7	11	Includes 3 Mayo Clinic cases reported above 1 case of pyelitis during pregnancy
Herman and Greene <sup>20</sup>	1944	Randall and Hardwick Turner, 1943 5 unreported cases	26	36	29	7	37	7	11	1 case with stone removed twice from right kidney and ureter 1 case with cesarean section at 6 months for ureteral dilatation
Rubovits and Arnkoff <sup>7</sup>	1949	Randall and Hardwick: 4 not included in above review 1 case	25	33	27	6	34	8	14	3 cases without transplant 1 case with cesarean section and sterilization 1 case with vaginal cesarean section with perforation of the head
Total cases			31	41	33	8	42	8	14	
Additional cases										
Cabot <sup>21</sup>	1931		2	3	3		3			
Green Armytage <sup>22</sup>	1932		1	1		1	1			
Lanman <sup>15</sup>	1950		1	1	1		1		1	
Hinman <sup>23</sup>	1951		2	2	1	1	2			
Total cases found			37	48	38	10	49	8	15	18 cases without ureteral transplant



At least 18 of these patients had not had ureteral transplants. Pyelitis complicated one pregnancy, and one patient had a cesarean section at six months for ureteral dilatation, with neonatal death. One woman delivered 3 children; during her reproductive period, stones were twice removed from the right kidney and ureter. One vaginal cesarean section, with perforation of the head, was done for obstructed labor.

To this series, I would like to add one case in which there are two living children.

A two-stage ureterosigmoid transplant and plastic repair of the anterior abdominal wall were done on this patient in 1930, at the age of 3 years, by Dr. E. C. Janes, at the Hamilton General Hospital. There was no evidence of urinary tract infection, and the postoperative course was uneventful. Follow-up examination revealed good urinary control, and the patient was symptom free.

This girl had a short vagina, with marked narrowing of the introitus, although the internal organs of reproduction felt normal on rectal examination. Menstruation began at the age of 13 and has been normal in rhythm and amount. A plastic enlargement of the introitus was done in 1946 in anticipation of her marriage the following year, and coitus has been satisfactory.

The patient reported for prenatal care in February, 1950. Her last menstrual period had occurred in November of the previous year. On March 1, 1950, at 13 weeks' amenorrhea, the blood pressure was 130/65 mm. Hg; blood urea, 16.9 mg. per cent; serum albumin, 5.31 mg. per cent; serum globulin, 1.09 mg. per cent; serum protein, 6.4 mg. per cent; creatinine, 0.85 mg. per cent. Intravenous pyelography showed a moderate bilateral hydronephrosis with some hydroureter. Kidney function was grossly normal, and there was good drainage.

X-ray examination of the pelvis revealed a large, roughly heart-shaped inlet with marked inward projection of the sacrum, and a 10.5 cm. gap between the rami anteriorly. The lateral view showed sharp forward angulation of the mid-portion of the sacrum, and small sacrosclatic notches. The poor obstetrical posterior pelvis appeared to be counterbalanced by the large gap between the pubic rami anteriorly. A vaginal delivery was therefore considered probable.

Pregnancy was uneventful. The blood pressure did not rise above 130/65 mm. Hg, and the blood urea remained below 13 mg. per cent. No symptoms of pyelitis developed. Intravenous pyelography at 24 weeks showed a slight increase in the degree of hydronephrosis in comparison with that shown in the previous film, but drainage was still good.

She was delivered on Oct. 4, 1950, by Dr. A. M. Pain, about two weeks after her expected date. The early part of labor was characterized by weak and ineffectual contractions. When the contractions became strong, labor progressed rapidly and an easy breech delivery of a normal 6 pound, 4 ounce, boy was accomplished, after deep mesio-lateral episiotomy. Her postpartum course was uneventful, and on examination eight weeks after delivery the blood pressure was 130/75 mm. Hg and the blood urea 12 mg. per cent. Intravenous pyelography showed that the hydronephrosis had regressed to that shown at 13 weeks, and excretion of the dye appeared even better than at that time. Pelvic examination revealed a second-degree prolapse of the uterus and a downward bulging of the anterior vaginal wall which required a pessary for support.

The second pregnancy began in April, 1952. At 12 weeks the patient complained of loin pain, chills, and kidney tenderness. This was very suggestive of pyelitis, and responded promptly to Gantrisin and fluids. The blood pressure, urea nitrogen, and weight gain remained within normal limits throughout the pregnancy. Intravenous pyelography at 36 weeks revealed a moderate hydronephrosis, more marked on the right side, and slightly greater than on the postnatal film of Nov. 30, 1950. Kidney function, however, was good.

Spontaneous rupture of the membranes occurred about 10 P.M., Jan. 16, 1953, without the onset of labor. The following morning a Pitocin drip was started without effect. It was repeated the next day, and strong regular contractions began about 5 P.M. At 10:30 P.M. on Jan. 18, 1953, a healthy, living female infant, weighing 5 pounds, 10½ ounces, was delivered as a footling breech, after deep mesiolateral episiotomy. The puerperium was uneventful.

Postnatal examination in eight weeks' time revealed a slightly increased prolapse. The blood pressure was 130/65 mm. Hg, the blood urea 16.3 mg. per cent. The intravenous pyelogram, on March 19, 1953, showed less hydronephrosis than on the film at 36 weeks, but there was no change on comparison with the postpartum films of Nov. 30, 1950.

Randall and Hardwick,<sup>19</sup> in 1934, observed that, as few of these girls lived long enough to reproduce, this complication in pregnancy had received little consideration. With the advent of satisfactory ureterosigmoid transplant, more patients will survive, and, as their reproductive function is usually normal, the complication of ectopia vesicae in pregnancy will be more frequently encountered.

Before pregnancy is permitted, renal function should be normal, and there should be no evidence of infection.<sup>19</sup> Hinman<sup>23</sup> lists as other contraindications (1) the possible transmission of the defect, (2) possible damage to the genital tract, and (3) possible renal damage.

No evidence of the transmission of the defect was found in the present review. Because of the weakened genital tract supports, the incidence of prolapse in this condition will be greater than in normal women. This has been used by some as an indication for cesarean section. However, at least 3 cases of nulliparous women with exstrophy of the bladder and prolapse have been reported in the literature.<sup>19, 24</sup> In addition, Hinman<sup>23</sup> points out that repeated operation will further weaken the already extensively scarred abdominal wall. As prolapse was reported in only sixteen of the thirty-eight women in this review, after fifty deliveries, cesarean section does not seem to be warranted for this reason.

The possibility of renal damage due to pressure and hormonal changes resulting in obstruction, stasis, and infection comes to mind immediately in these cases, as the ureters will undergo the normal physiological changes of pregnancy and there will be the usual compression of the ureters by the enlarging uterus. In our case no evidence of serious renal damage could be demonstrated, although the patient had one attack suggesting pyelitis. Little evidence of renal damage as a result of pregnancy could be found in the cases reported in the literature.

Unless marked renal obstruction and infection exist, with serious diminution in kidney function, these women should be allowed to bear children. Progress during pregnancy should be followed by observation of blood pressure, weight gain, the ocular fundi, and nonprotein nitrogen and serum protein determinations.

Some authors<sup>17, 18</sup> believe dystocia to be very common in women with exstrophy of the bladder. Others,<sup>19, 20, 25</sup> with whom I agree, anticipate normal delivery in most cases. It is pointed out that "The pelvic cavity is usually of justo major proportions with a defect of several centimeters in the

anterior portion of the girdle, so that disproportion in the ordinary sense between the presenting part and the pelvis will not exist."<sup>19</sup> In this review 40 of the 50 babies were delivered by the vaginal route, without untoward difficulty in most cases.

Labor and delivery should be conducted in the normal manner, with the realization that breech and even compound presentations probably occur more frequently than usual<sup>19</sup> and require the proper obstetrical treatment. Early mesiolateral episiotomy is indicated, to protect the perineum and the anal sphincter, which are displaced forward in this condition, and it should be remembered that the peritoneum is very close to the anterior vaginal wall.

### Conclusions

1. The reproductive function in females with ectopia vesicae is usually normal.
2. Early ureterosigmoid transplant will increase the number of these patients who survive to the reproductive age. Thus, this complication of pregnancy should become more frequent.
3. No evidence was found of transmission of the defect.
4. Kidney function seems to be unimpaired by pregnancy and delivery.
5. Cesarean section is not indicated for this condition per se.
6. Most patients can be delivered vaginally.
7. Early deep mesiolateral episiotomy is indicated to protect the anal sphincter.
8. With or without pregnancy, the incidence of prolapse of the uterus is increased in this congenital abnormality.

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## THE PROGNOSIS OF CARCINOMA OF THE CERVIX UTERI BY VAGINAL SMEAR\*

### A Preliminary Report

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**R**ADIO THERAPY has been the generally accepted method of treatment of carcinoma of the cervix uteri for the past thirty years. Even in clinics such as Chelsea Hospital for Women, London, England, where Bonney<sup>1</sup> practiced his Wertheim modification, Read<sup>2</sup> reports that the operative incidence of 63 per cent has fallen to 14 per cent. In very recent years this widespread preference for radiotherapy has been challenged by those who see improving surgical conditions today, and who claim that radiotherapy has failed to improve its survival rates during the past decade.

One recognizes the reason for five-year survival figures as low as 30 and 35 per cent when in only a small percentage of cases is the disease confined to the cervix at the time of initial treatment. More disturbing is the fact that radiotherapy fails to cure 45 per cent of Stage I and early Stage II lesions. Furthermore, when one eliminates such factors as (1) too optimistic clinical staging at initial treatment, (2) death from radiotherapy, and (3) death from other disease, there remains a substantial group of patients with Stage I and early Stage II cases who fail to survive five years. This was clearly indicated by Cosbie<sup>3</sup> in 1951, who concluded that this latter group represented the problem of radioresistance. This concept of radioresistance by clinical observation has been the basis for reconsideration of radical surgery, as pioneered by Meigs.<sup>4</sup>

Studies of biopsies during treatment with radiation have been reported by Frankle and Amreich<sup>5</sup> in 1921, Dustin<sup>6</sup> in 1927, Meigs and Parker<sup>7</sup> in 1930, Frola<sup>8</sup> in 1933, Arneson and Stewart<sup>9</sup> in 1935, Warren and associates<sup>10</sup> in 1939, and Glucksmann and Spear<sup>11</sup> in 1945 and in 1952.<sup>12</sup> The descriptions were similar but more detailed in each succeeding paper. Glucksmann and Spear, in studying biopsies taken at the growing edge of the tumor following an initial radium treatment to the cervix, predicted that the presence of persistent carcinoma cells (mitotic and resting) represented an unfavorable response to treatment.

Following the work of Papanicolaou and Traut<sup>12</sup> showing the values of cytology, Graham<sup>13</sup> in 1947 described the cellular changes seen in benign cells of the vaginal smear during and following radiation therapy. Maloney<sup>15</sup> in 1949 described persistent malignant cells in the smears of patients whom radiotherapy failed to cure.

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These cytologic changes under the influence of radiation are quite comparable to those described in the study of biopsies from radiated patients. The two methods provide differences in the scope of description; the biopsy is restricted to tumor changes, but the vaginal smear permits observation of all types of desquamated cells both benign and malignant; on the other hand, the biopsy allows observation of cellular change deeper in the tumor, while the vaginal smear is restricted to study of surface tissue. From a practical viewpoint, smears have the advantage of being easier to take in large numbers during therapy. It would seem that the two methods, biopsy and smear, have enhanced value when studied together in the same patient.

We feel that the prognostic value of these two methods as aids in the selection of the method of treatment should be vigorously pursued in a large series of cases. As yet we have an insufficient number tested by the biopsy method, but smear studies have been done by us since 1949. The results in the present series are presented to-day.

### Material

Patients for this study attend the gynecology clinic at the Ontario Institute of Radiotherapy, Toronto General Hospital. Since it seemed unlikely that surgical methods would ever be used in late disease, we decided to confine our study to Stage I and II (Schmitz) carcinoma of the cervix. During the past year we have changed our staging to that approved by the World Health Organization, and our future studies will be confined to Stage I (WHO).

The routine radiation therapy in our clinic is high-voltage x-ray followed by radium therapy. For the purpose of this study it was agreed to reverse the usual treatment sequence, so that we could observe the cellular changes following radium therapy alone. Cellular changes due to high voltage x-ray were also studied as treatment progressed. Vaginal smears were taken on each patient (1) before treatment, (2) after radium therapy, (3) at each week of high voltage x-ray therapy, and (4) at each visit following therapy.

The therapy routine for these early cases was as follows: intrauterine radium  $2 \times 20$  mg. in tandem in 1 mm. platinum shield, is used for 4,200 mg. hr.; intravaginal radium,  $2 \times 30$  mg. for 2,100 mg. hr. is applied twice. Radium therapy is completed within two weeks, giving a total radium dosage to the primary site of 8,400 mg. hr. After four weeks' rest, 400 kv. x-ray therapy is begun, using 300 r daily on one port until each of six external ports (two anterior, two posterior, two lateral pelvic) have received 1,800 r total air dose. X-ray therapy is completed in five weeks, giving total x-ray air dose of over 10,000 r.

### Records

In accordance with the Graham<sup>14, 16</sup> criteria, the following changes in benign vaginal cells were recorded in each smear: vacuolation, nuclear changes, increase in cell size, multiple nuclei, bizarre late cellular changes. If more than 75 per cent of benign vaginal cells showed these changes, a good response was recorded. If less than 65 per cent of benign vaginal cells showed the changes, a poor response was recorded. Because of Maloney's<sup>15</sup> previous findings, the presence of malignant cells was also recorded. As Graham<sup>13</sup> observes, the diagnosis of malignancy in radiated smears is difficult due to the presence

of bizarre radiated vaginal cells which can simulate differentiated malignant cells. Therefore, care was taken to restrict the diagnosis of malignant cells to the undifferentiated forms.

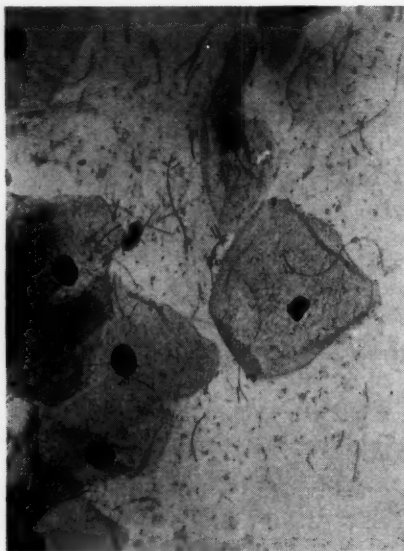


Fig. 1.

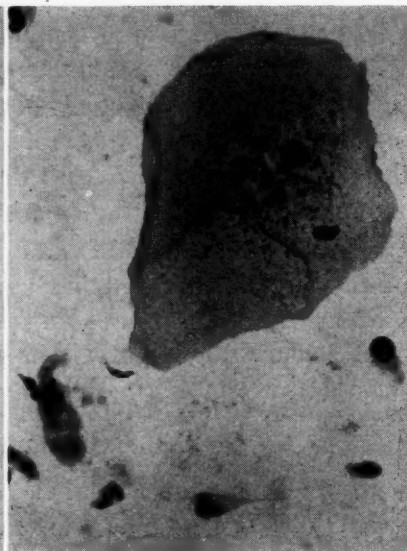


Fig. 2.

Fig. 1.—Superficial-type vaginal cells seen in the vaginal smear prior to treatment. ( $\times 404$ ; reduced  $\frac{1}{4}$ .)

Fig. 2.—Superficial-type vaginal cells in the vaginal smear following radium therapy and following two weeks of high-voltage x-ray therapy. The cell shown is obviously uniformly enlarged several times. ( $\times 404$ ; reduced  $\frac{1}{4}$ .)

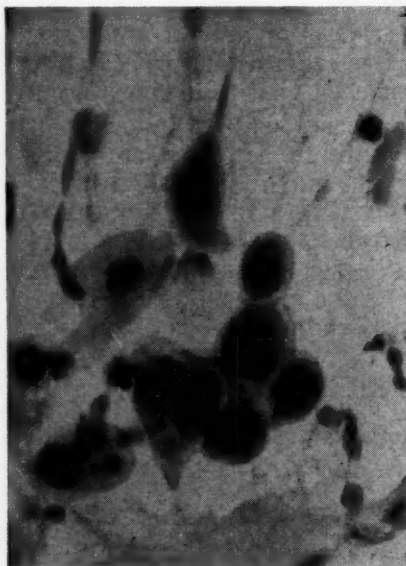


Fig. 3.

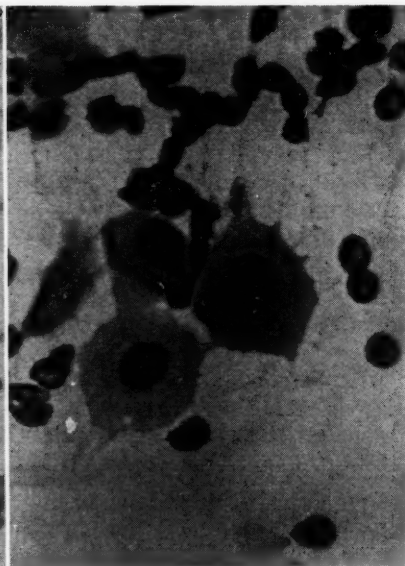


Fig. 4.

Fig. 3.—Malignant cells seen prior to treatment. ( $\times 672$ ; reduced  $\frac{1}{4}$ .)

Fig. 4.—Basal-type vaginal cells in the vaginal smear prior to treatment. ( $\times 672$ ; reduced  $\frac{1}{4}$ .)

### Results

Of the 116 patients with Stage I and II (Schmitz) carcinoma of the cervix under study, 38 patients have been followed at least three years, and form the basis for this three-year preliminary report.

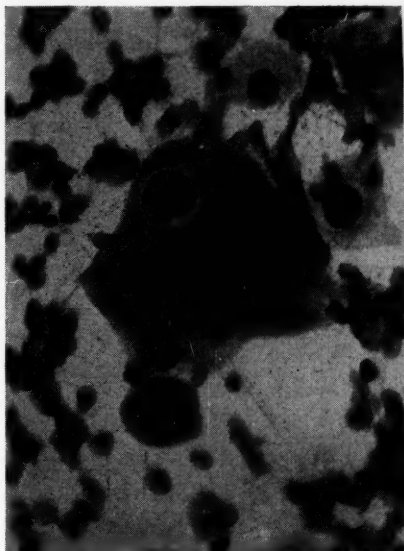


Fig. 5.

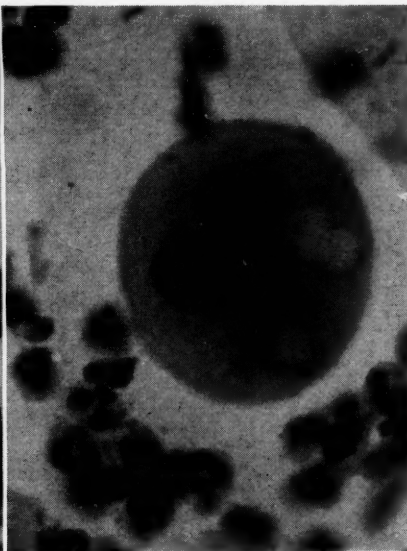


Fig. 6.

Fig. 5.—Basal-type vaginal cell in the vaginal smear following radium therapy and following two weeks of high-voltage x-ray therapy. The cell is enlarged, vacuolated, double-nucleated, and phagocytic with polymorphonuclear leukocytes. A relatively unaffected basal-type cell is seen just below. ( $\times 672$ ; reduced  $\frac{1}{4}$ .)

Fig. 6.—Basal-type vaginal cell is seen in smear following therapy as described in Fig. 5. The cell demonstrates vacuolation and double nuclei. ( $\times 1008$ ; reduced  $\frac{1}{4}$ .)

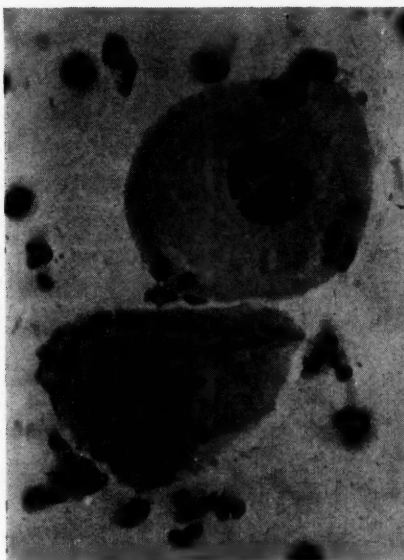


Fig. 7.

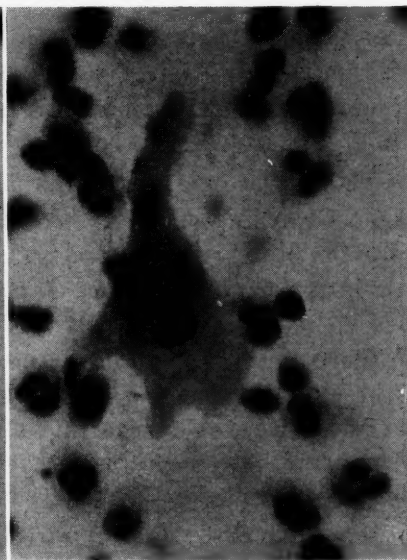


Fig. 8.

Fig. 7.—Intermediate-type vaginal cell shows nuclear fragmentation following therapy described in Fig. 5. ( $\times 672$ ; reduced  $\frac{1}{4}$ .)

Fig. 8.—Basal-type vaginal cell is seen with bizarre changes of the entire structure, following the same stage in therapy as indicated in Fig. 5. ( $\times 1008$ , reduced  $\frac{1}{4}$ .)

Tables I and II show the three-year survival of patients in good- and poor-response groups, using the Graham criteria concerning changes in benign vaginal cells.

TABLE I. RESPONSE OF BENIGN VAGINAL CELLS IN CASES OF CARCINOMA OF THE CERVIX  
UTERI TO RADIUM THERAPY

38 PATIENTS, THREE-YEAR ABSOLUTE SURVIVAL

	GOOD RESPONSE			POOR RESPONSE		
	NO.	SURVIVAL		NO.	SURVIVAL	
		NO.	%		NO.	%
Stage I	7	4	57	7	5	71
Stage II	13	6	46	11	5	45
Total	20	10	50	18	10	55
Prognostic accuracy			50			45

TABLE II. RESPONSE OF BENIGN VAGINAL CELLS IN CASES OF CARCINOMA OF THE CERVIX  
UTERI TO RADIUM AND X-RAY

38 PATIENTS, THREE-YEAR ABSOLUTE SURVIVAL

	GOOD RESPONSE			POOR RESPONSE		
	NO.	SURVIVAL		NO.	SURVIVAL	
		NO.	%		NO.	%
Stage I	13	9	69	1	0	—
Stage II	19	10	52	5	1	20
Total	32	19	59	6	1	17
Prognostic accuracy			59			83

### Comment

In our present study the prognostic value of the vaginal smear following radium therapy alone is poor, survival figures being approximately the same (50 per cent and 55 per cent) in both good- and poor-response groups (Table I). In future we will take smears more frequently during the radium phase of therapy to give the smear method a fairer trial.

The survival figures in good- and poor-response groups following radium and x-ray therapy are very different, 59 per cent and 17 per cent, respectively (Table II). Graham's cases received a lower dosage of radiation which may account for the high percentage of patients in the poor-response group and the low over-all survival rate. Of the 67 Stage I and II cases in Graham's<sup>16</sup> series, there were 42 patients in the good-response group with 71 per cent five-year survival; there were 25 cases in the poor-response group with none surviving. Yet, in these two separate studies there is a similar trend in the results, namely, a vast difference in survival rate in the good- and poor-response groups. It would appear that an effort to repeat Graham's work with a larger series of early cases is justified.

One notes that the survival rate in the good-response group was disappointingly low. The reason becomes evident when one enquires into the causes of death in this group. Bearing in mind that we are studying radiosensitivity and not radiocurability, we should possibly exclude the following deaths in



the good-response group: radiation deaths (no cancer) 2, and deaths from distant metastases (no pelvic cancer) 2. This raises the accuracy of the vaginal smear in the good response group from 59 to 72 per cent.

In accordance with Maloney,<sup>15</sup> who found correlation between cases with persistent malignant smears and death, we note that we have 5 such cases in our good-response group and all these patients are dead. If these cases were to be transferred to the poor-response group as Maloney practiced there would be only 4 deaths remaining in the good-response group, including 3 patients untraced during the past year but known to be alive and well for two years following treatment. Thus we must admit that there is a possibility that the accuracy of prognosis by vaginal smear should be expressed in the form of net results rather than absolute results. After all, we are testing a diagnostic aid rather than a method of treatment. Such net results are indicated in Table III.

TABLE III. STUDIES OF BENIGN AND MALIGNANT CELLS IN CARCINOMA OF THE CERVIX UTERI FOLLOWING FULL TREATMENT

38 PATIENTS, THREE-YEAR NET SURVIVAL

	GOOD RESPONSE			POOR RESPONSE		
	NO.	SURVIVAL		NO.	SURVIVAL	
		NO.	%		NO.	%
Stages I and II	27	23	85	11	1	9
Prognostic accuracy			85			91

One must not presume that our efforts to improve the absolute figures by transfer to net results brings us to any fixed conclusions which cannot be shaken by future experience. It remains to be seen if the repetition of Graham's<sup>16</sup> and Maloney's<sup>15</sup> work with a larger series of cases and five-year follow-up will substantiate their previous claims. At the same time the results of biopsy study on the same patients should be recorded in an effort to repeat the work of Glucksmann and Spear.<sup>11</sup> Furthermore, Graham and Graham<sup>17</sup> have described certain characteristics in the benign vaginal cells of radio-sensitive patients which can be demonstrated even before they receive radiotherapy. Such an observation is indeed worthy of repeat study.

### Conclusions

1. A preliminary report of the value of the vaginal smear in the prognosis of early cervical carcinoma during the period of complete radiotherapy is presented. Thirty-eight cases have been followed three years.
2. Prognosis by studying benign vaginal cells gave absolute survival accuracy of 59 per cent in the good-response group and of 83 per cent in the poor-response group; net survival accuracy was 72 per cent in the good-response group and 83 per cent in the poor-response group.
3. Prognosis by studying benign and malignant cells gave even better accuracy. The net survival accuracy was 85 per cent in the good-response group and 91 per cent in the poor-response group.

4. Prognosis by studying smears following initial radium therapy were valueless, but this study should be repeated with more frequent smears during therapy before a final decision is reached in this matter.

5. It is believed that these differences in survival figures in the good- and poor-response groups are significant and that further study of a larger series for a longer period is justified.

This study has been made possible by the much-appreciated generosity of the Ontario Cancer Treatment and Research Foundation. Grateful acknowledgment is expressed to Dr. D. E. Cannell and to Dr. W. G. Cosbie for their aid in editing this manuscript. The cheerful and unfailing assistance of Miss Mabel Clark in our laboratory is deeply appreciated.

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MEDICAL ARTS BUILDING,  
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## A STUDY OF CERVICES REMOVED AT TOTAL HYSTERECTOMY FOR BENIGN DISEASE\*

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**D**URING the past eighteen years it has been our custom at the Toronto Western Hospital to perform total rather than subtotal hysterectomy for benign pelvic disease, unless there were very definite contraindications to the complete operation. This same trend has been evident in most major centers. There seems to be little doubt now that total hysterectomy is the procedure of choice, where it is possible, without undue difficulty. The various complications that can arise from a cervical stump left behind at an incomplete operation have been well documented. We have been interested in discovering just what pathological lesions are being found in the cervixes routinely removed at total hysterectomy, with a view to finding out just what sort of trouble we are avoiding. Vaginal hysterectomies have not been included because they are frequently performed for prolapse, in which case the cervix may have been exposed to different conditions.

This paper is a review of the pathological conditions found in the routine cervical sections taken from 800 consecutive total abdominal hysterectomies for benign disease. The material covers the period from January, 1948, to July, 1952, just four and one-half years. All available sections in that period were examined. The information included was obtained entirely from the pathological reports and the microscopic sections. The only clinical notes used are those found on the pathological reports. We have been particularly interested in the over-all picture of the pathology in these cervixes and, at the same time, in watching for any evidence of cancer. Malignancies, apart from carcinoma in situ, have been excluded because, when they are diagnosed, radical procedures are the rule.

Of these 800 cases, the patients' age was recorded in 762. The youngest was 24 years of age and the oldest 77, giving an average age of 43.3 years. The gross and microscopic pathology of the uterine body and the adnexa has also been noted (Table I). This does not necessarily reflect the indications for operation, but merely indicates the relative frequency of the various lesions as found in the laboratory. In some cases the indications for operation were listed but no pathological condition was found, for example, in the 55 cases in which the operation was done for functional bleeding. There were also 91 cases in which there was no pathological condition and no reason was listed for surgery. Of the total group, there were 150 cases which showed more than one

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type of pathology, that is, 18.7 per cent. The only finding which appears to be out of line is the presence of adenomyosis in 11.1 per cent of the series. However, this is a microscopic diagnosis, and even the cases with the slightest evidence were tabulated.

TABLE I. FINDINGS AT TOTAL HYSTERECTOMY FOR BENIGN DISEASE

Uterine Body and Adnexa		800 cases	
More than one lesion		150 cases, 18.7%	
FINDINGS	NO. CASES	PERCENTAGE	
Leiomyomas	396	49.5	
Endometrial hyperplasia	94	11.7	
Adenomyosis	89	11.1	
Ovarian cysts and cystic ovaries	62	7.7	
Fibrosis uteri	58	7.3	
Endometrial polyps	41	5.0	
Pelvic inflammatory disease	30	3.7	
Endometriosis	28	3.5	
Functional uterine bleeding	55	6.8	
Dysmenorrhea	12	1.5	
Atrophy of the endometrium	11	1.4	
Decidua or placental tissue	3	0.4	
Normal uterus	91	11.4	

The findings in the cervixes are shown in Table II. There are several factors here which are certainly open to criticism. On the basis of our material we have no way of knowing how much or how often the condition of the cervix influenced the operator in his decision to do a total hysterectomy. Also, we presume that the resident pathologist who cut the sections took them from the worst part of the cervix. On the other hand, some of these women may have been using healing douches for a period prior to operation, and thus may have improved the appearance of a badly infected cervix.

TABLE II. CERVICAL FINDINGS AT TOTAL HYSTERECTOMY FOR BENIGN DISEASE

Cervix		800 cases	
More than one lesion		152 cases, 19.0%	
PATHOLOGY	NO. CASES	PERCENTAGE	
Histologically normal	291	36.4	
Chronic cervicitis	273	34.1	
Nabothian follicles	227	28.4	
Squamous metaplasia	78	9.7	
Erosion	31	3.9	
Benign polyp	24	3.0	
Basal-cell hypertrophy	21	2.6	
Glandular hyperplasia	18	2.2	
Acute cervicitis	12	2.0	
Atrophy	6	0.7	
Intraepithelial carcinoma	3	0.4	

Of the 800 cases reviewed, 291, or 36.4 per cent, were histologically normal. In other words, 63.6 per cent of these cervixes showed some definite lesion, regardless of its significance. Of the total number, 152 cervixes, or 19.0 per cent, showed more than one pathological condition. Of all the findings, chronic cervicitis was the most common, occurring in 273 cases, or 34.1 per cent. Nabothian follicles were present in 227 cases, or 28.4 per cent. Squamous metaplasia or benign epidermization was found in 78 cases, or 9.7 per



cent. Benign cervical erosion was present in 31 cases, or 3.9 per cent; benign polyps in 24 cases, or 3.0 per cent; basal-cell hypertrophy in 21 cases, or 2.6 per cent; glandular hyperplasia in 18 cases, or 2.2 per cent; acute cervicitis in 12 cases, or 2 per cent; atrophy in 6 cases, or 0.7 per cent; and intraepithelial carcinoma in 3 cases, or 0.4 per cent.

The significance of some of these pathological conditions in the production of symptoms might appear to be questionable. However, we are of the opinion that symptoms would develop or persist if a diseased cervix were left. An infected cervix can produce leukorrhea, bleeding, pelvic pain, and dysuria. We think that unpleasant symptoms, sufficient to make operative results much less satisfactory, would be present in a large proportion of cases, if incomplete operations were performed. Our findings of 63.6 per cent of cervixes already diseased to a large extent substantiate this. It is also very largely accepted that a chronically irritated cervix is more likely to develop carcinoma.

Stein and Kaye<sup>44</sup> report that the commonest lesions which occur after incomplete hysterectomy are bleeding, mucopurulent discharge, and prolapse of the stump. To this I would like to add pelvic pain. This is corroborated by Collins, Schneider, and Baggs,<sup>1</sup> who, in a critical analysis of 226 cervical stumps sufficiently diseased to warrant removal, found that the most common complaint was pelvic pain, which occurred in 49.5 per cent of all cases. They also found that 46.4 per cent of patients complained of leukorrhea and 37.1 per cent had a bloody discharge. Chronic cervicitis with or without erosion or ulceration was responsible for 62 per cent of the total complaints. The painful symptoms initiated and maintained by chronic cervicitis are due to lymphatic extension of the responsible organisms. It would appear, therefore, that since, in our series, a large number of cervixes were infected at the time of removal, the possibility of unpleasant symptoms occurring, if they had been left, was great.

The role of benign cervical lesions in the production of carcinoma is, to say the least, controversial. Novak<sup>5</sup> has said that "while the irreversible cancer change is intracellular and intrinsic, it may be influenced and incited by such extrinsic factors as chronic irritations of one sort or another." Squamous metaplasia is regarded by some as predisposing to the development of cancer, but Townsend and Sturbridge,<sup>3</sup> in a review of 2,221 cases, found that squamous metaplasia does not predispose to carcinoma any more than any other chronic irritating lesion of the cervix. Basal-cell hypertrophy is regarded by many as a very early stage of cervical carcinoma. This too is open to doubt. Benign polyps, if undetected, would almost certainly produce bleeding, if left in a cervical stump. Acute cervicitis, glandular hyperplasia, and erosion are very likely to continue an annoying discharge.

### Conclusions

In the opinion of the majority of clinicians benign cervical disease is a frequent cause of pelvic pain, leukorrhea, bloody discharge, backache, "bearing down sensations," dyspareunia, and dysuria. It is also evident that benign

cervical irritations are a factor in the production of cervical carcinoma in those genetically predisposed. Since 63.6 per cent of the cervixes in our series were already the seat of benign disease at the time of removal, it would seem that total hysterectomy, in addition to preventing cervical carcinoma, also prevents many unpleasant symptoms.

### Summary

1. The cervixes removed in 800 total abdominal hysterectomies for benign disease have been examined.

2. It was found that 63.6 per cent of these cervixes were diseased at the time of removal.

3. Since a diseased cervical stump can produce serious pelvic symptoms, and since a large number of cervixes are diseased at the time of hysterectomy, it is our contention that, even apart from the danger of carcinoma, subtotal hysterectomy should rarely be performed.

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## ANALYTICAL STUDY OF 220 CASES OF STERILITY\*

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THIS study is based upon a group of patients examined for sterility of three types: primary, of at least two years' duration; secondary or acquired, after a lengthy period of infertility; and, finally, relative, that is after one or several miscarriages. Whenever two etiological factors were concerned, the more important was used for our statistical purposes.

### Methods of Study

Hysterosalpingography was performed in every case, on the one hand to establish clearly the state of permeability of the tubes and on the other to reveal any possible lesion which might otherwise have been overlooked. This examination, done on a large scale at the Clinic of Gynecology of the Notre Dame Hospital has, in fact, permitted us to establish an exact diagnosis in a large number of cases and consequently to administer without delay the appropriate medical or surgical treatment. Tubal insufflation has been used here solely for therapeutic purposes when lesions about the fimbria had already been visualized by hysterosalpingography.

Ovulation, a phenomenon obviously indispensable to fertility, can be studied indirectly. Three methods are especially popular: the temperature curve, endometrial biopsy, and the vaginal smear. The temperature curve, seemingly a simple procedure, actually requires several months of practice on the part of the patient before it can be relied on to give satisfactory results. Endometrial biopsy gives the most accurate information on ovarian function and, furthermore, permits an evaluation of the efficacy of prolonged hormonal medication. The vaginal smear is also extremely valuable but less practical because of the frequent difficulty encountered in its interpretation. This is especially true in the presence of infection, which further increases the complexity and unreliability of the smear.

Cervical and vaginal secretions were examined routinely because the altered pH can greatly diminish fertility. In cases where the pH was found to be abnormal the postcoital examination (Huhner's test) was performed. Among other "complementary" tests sometimes useful should be noted the basal metabolic rate, the routine blood tests, Rh factor studies, hormonal titrations, and certain routine x-ray examinations.

It is not permissible nowadays to consider the woman as the one solely responsible for a sterile marriage. Thus, before carrying out numerous complicated examinations of the wife, the majority of American clinics now investigate the husband. We have unfortunately been unable to follow this practice but, in several cases where the wife was completely normal, examination of the husband revealed some form of genital pathology.

Here also, as in so many other fields, we find ourselves confronted with the unknown. How are we to explain the prolonged sterility of 27 seemingly normal

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cases? How are we to understand the advent of pregnancy to a desperate couple only after the adoption of a baby? Certain psychological factors such as anxiety, obsession, and frustrations probably create a particular state of mind which can exert a formidable influence on the female reproductive system.

TABLE I. FUNDAMENTAL EXAMINATIONS TO BE PERFORMED IN CASES OF STERILITY

1. Routine pelvic examination
2. Uterosalphingogram
3. Ovulation test
a. Basal temperature graph
b. Endometrial biopsy
4. Vaginal and cervical smears, determination of pH
5. Male factor study
6. Complementary tests

### Analysis of Causes of Sterility and Results of Therapy

The causes of sterility in the cases of this series are given in Table II under general headings and in Table III under the terms of a final precise diagnosis. In this study (Table II) the 96 cases which we have designated as favorable are those which underwent medical or surgical treatment aimed at increasing their probable fertility. The unfavorable cases, 124 in number, were those in which lesions discovered in the course of the investigation or at laparotomy were incompatible with pregnancy.

TABLE II. CLASSIFICATION OF 220 CASES ACCORDING TO CLINICAL DIAGNOSIS WITH RESPECT TO THE PRINCIPAL FACTOR IN STERILITY

<i>Uterus:</i>		
Anomalies	3	1.3%
Uterine tumors	25	11.3%
<i>Tubes:</i>		
Salpingitis	78	35.4%
<i>Factors.—</i>		
<i>Ovarian:</i>		
Unilateral tumors	11	5.0%
Bilateral tumors	2	0.9%
Endocrine disturbances	29	13.1%
<i>Cervical:</i>		
Endocervicitis	30	13.6%
<i>Male</i>	15	6.8%
<i>No significant pathology</i>	27	12.2%
<i>Résumé.—</i>		
Good prognosis	96	43.6%
Poor prognosis	124	56.4%

The general results of therapy are shown in Table IV, which shows that among the patients of the entire series, term pregnancies occurred in 25, or 11.3 per cent. If, however, one considers all the pregnancies that occurred in the patients with a good prognosis, 86 in number, the figure becomes 34.3 per cent.

The details of the cases in which pregnancies occurred are shown in Table V.

### Summary of Results in Favorable Cases

1. Among 6 cases of uterine tumor treated by myomectomy there were 1 term pregnancy and 2 miscarriages.



TABLE III. FINAL DIAGNOSIS FOR ALL CASES, AFTER COMPLETE INVESTIGATION

<i>Uterine Anomalies.</i> —		
Congenital absence (uterus and vagina)	1	1.3%
Bicornate uterus	1	
Didelphys uterus (partial septum)	1	
<i>Uterine Tumors.</i> —		
<i>Fibromas:</i>		
Submucous	5	
Subserous	3	
Interstitial	4	
Fundus	3	11.3%
Cervix	2	
Isthmus	1	
Endometrial endometriosis	7	
Total Uterine Factors	28	12.6%
<i>Salpingitis.</i> —		
<i>Tubal Obstruction:</i>		
Complete	11	
Partial	17	
Fimbria	15	
Bilateral hydrosalpinx	19	
Partial patency	16	
Total	78	35.4%
<i>Ovarian Tumors.</i> —		
<i>Unilateral:</i>		
Dermoid cysts	4	
Serous cysts	2	
Cystadenomas	1	
<i>Bilateral:</i>		
Mixed ovarian cysts	2	
Endometriosis	4	
Total ovarian tumors	13	5.9%
<i>Endocrine Disturbances.</i> —		
Thyro-ovarian insufficiency	10	
Uterine hypoplasia	5	
Endometrial atrophy	7	
Hyperplastic endometrium	7	
Total with endocrine disturbances	29	13.1%
<i>Miscellaneous Factors.</i> —		
Cervicitis	5	
Endocervicitis	8	
Endometritis	6	
Vaginitis	5	
Stenosis of external os	3	
Cervical polyp	3	
Total	30	13.6%
Male factor	15	6.8%
No significant pathology	27	12.2%

TABLE IV. RESULT OF TREATMENT

Poor prognosis	124	56.4%
Good prognosis	96	43.6%
Total	220	
Confirmed full-term pregnancies	25	11.3%
Pregnancies, final result unknown	2	
Pregnancies (abortions)	6	
Total	33	15.0%
Pregnancies in 96 cases with a good prognosis	33	34.3%

TABLE V. PREGNANCIES OBTAINED AFTER APPROPRIATE MEDICAL OR SURGICAL TREATMENT OF STERILITY DUE TO SPECIFIC CAUSES

FACTORS	DIAGNOSIS	MEDICAL THERAPY	SURGICAL THERAPY	TERM PREGNANCIES
Uterine	Subserous fibroma		Myomectomy	1
Tubal	Bilateral salpingitis	Insufflations		2
	Bilateral salpingitis	Combined		2
	Fimbrial salpingitis	Medical	Salpingectomy for ectopic	1
Ovarian	Functional	Medical		8
	Dermoid cyst		Ovariectomy	1
	Dysmenorrhea and uterine hypoplasia	Medical	Curettage, suspension Presacral neurectomy	1
Cervical	Cervical polyp		Curettage, polypectomy	1
	Endocervicitis	Medical Huhner test		3
	Stenosis, external os		Curettage	2
	Cervicitis	Medical Huhner test	Cauterization	1
				1
Male	Oligospermia	Endocrine		
No significant pathology	None			1
Total				25

2. The 32 patients with salpingitis were treated by such medical methods as antibiotics based on tests of sensitivity, diathermy, and tubal insufflation. There resulted 5 pregnancies, of which 2 followed insufflation. One of these was ectopic.

3. The 21 patients with various ovarian diseases were treated either medically or surgically, according to the nature of the lesion. There resulted 10 pregnancies and 2 miscarriages. Among these was one instance of excision of a dermoid cyst and one of uterine hypoplasia with dysmenorrhea. Combined hormonal therapy as proposed by Hamblen in conjunction with dilatation and curettage, presacral neurectomy, uterine suspension, and anovulatory cycles was the method of therapy in 10 cases.

4. Cervicitis and endocervicitis were the principal lesions in 30 cases. Examination of the secretions and the Huhner's test afforded the appropriate treatment. There resulted 7 pregnancies.

5. The male factor was the essential cause in 7 cases and among these 1 pregnancy resulted.

6. In 27 cases there was no determinable abnormality. Pregnancy occurred in 1 of these during the period of observation.

### Conclusions

When dealing with sterility, it is indispensable to have recourse to the basic examinations, both clinical and laboratory, so as to establish the diagnosis promptly and to determine whether the prognosis in a given case is more or less favorable.

Hysterosalpingography is an invaluable aid not only for investigating the permeability of the tubes but also for the detection of numerous internal lesions which might otherwise be overlooked.

We have presented 220 cases examined and treated for sterility. Among this group, 25 verified full-term pregnancies have occurred during a 3-year period.

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## AN ANATOMICAL CONTRIBUTION TO THE PROBLEM OF CONTINENCE AND INCONTINENCE IN THE FEMALE\*

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THE ingenious endeavors of numerous prominent gynecologists to devise new operative procedures for incontinence prove that the struggle against the extremely distressing phenomenon of incontinence has not been satisfactorily solved up to the present.

An accurate knowledge of the anatomy and physiology of the involved part is naturally necessary, and it is worthy of mention that the research work on this problem was done, not by the anatomists, but by the clinicians who were repeatedly confronted with the failures of their operative procedures. Let us recall at this juncture the remark of Mr. Charles D. Read, of Chelsea Hospital, London, England, speaking at a staff conference of the Royal Victoria Montreal Maternity Hospital, March 31, 1948, on the Millin-Read sling operation, that *this operation should be performed only after the usual procedures have failed.*

The old anatomical concept of a simple circular sphincter analogous to the sphincter ani was overthrown by Waldeyer's pupil Kalischer, in 1900, who studied the problem for five years, and was able to point out that the muscular arrangements are much more intricate than was previously supposed by the older anatomists. Kalischer was also the first to emphasize that it was impossible to show with microscopic dissection the exact delineation of the different muscle bundles involved in the act of micturition, and therefore he used the micro-anatomical method. The demonstration of the participating muscle structures in the act of micturition did not agree with the findings noted in young children, as in parous women multiple damage without any manifest impairment of continence is usually encountered, being the result of birth trauma.

It was to Kalischer's credit that the discussion was opened concerning which part of the urethra dominates in the closure mechanism of the bladder, or which part of the bladder acts as a sphincter to close the origin of the urethra in the bladder; in other words, which muscle bundles close the internal vesical os.

Much has been written and recopied, but comparatively little real actual dissection added to our knowledge.

### Review of Some of the More Important Literature

Kalischer introduced the concept of the trigonal sphincter as shown in Figs. 1 and 1A. This broke with the usual idea of an annular arrangement of

\*Presented at the Annual Meeting of the Society of Obstetricians and Gynaecologists of Canada at Digby, Nova Scotia, June 23 to 25, 1950. (Publication has been delayed owing to the loss of the manuscript in the mail.)



muscles acting as a sphincter; furthermore, he showed the change in the distribution of the muscular covers of the urethra from the meatus cranially toward the free part of the urethra.

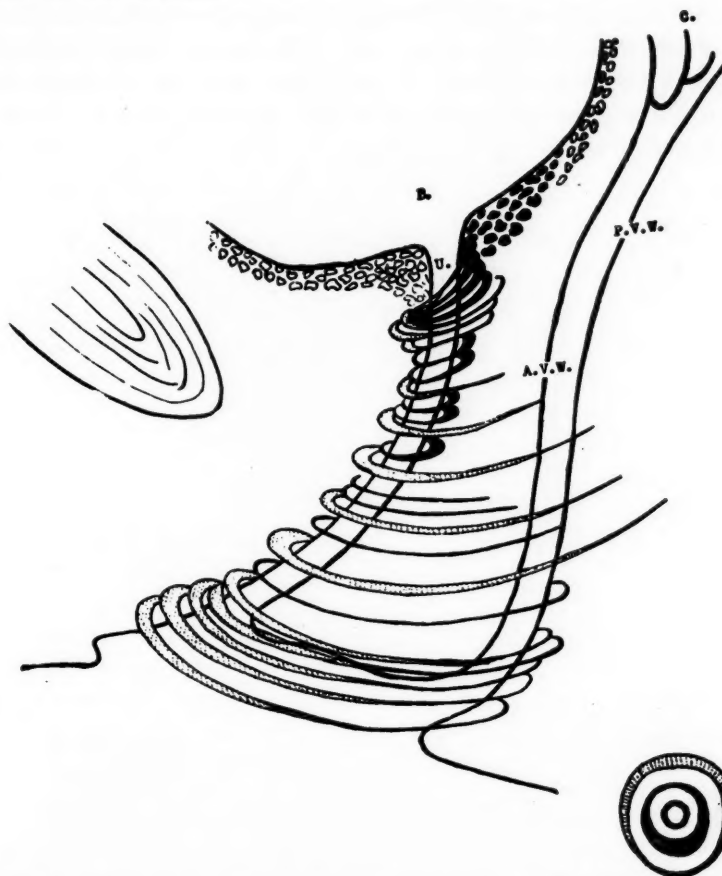


Fig. 1.—Ureteral muscular arrangement. *B*, Bladder. *U*, Urethra. Dotted lines, Striated muscle. Blacked-out lines and spots, Smooth muscle of trigone and urethra. Empty spaces, Bladder fibers. *C*, Cervix. *A.V.W.*, Anterior vaginal wall. *P.V.W.*, Posterior vaginal wall. Insert, Frontal section near vesical orifice. (Figure modified after Zangemeister.)

The striated musculature is external to the smooth muscle. The former has its maximum thickness below and the latter above; moreover, the fibers of both systems become more oblique at each extremity of the urethra.

Zangemeister focused his attention especially on the urethral musculature, pointing out that no annular contraction occurs, but an anterior and posterior apposition of the urethral walls. He also attributes an important part of the maintenance of closure to the tangential origin of the urethra from the bladder. Modern operative plastic procedures aim to restore this vesicourethral angle in the cure of stress incontinence. Zangemeister stated that the upper end of the smooth musculature of the urethra arises from the bladder trigone, a fact which, though not shown by dissections, could be interpreted as a presentment of Heiss and Wesson's later work. He also drew attention to the fact that striated as well as smooth muscle surrounds the urethra and vagina obliquely (Fig. 1). The direction of these fibers may explain the shortening of the urethra during micturition which has been observed by Kennedy and others.

Robert Heiss, in 1915, after the dissection of some 40 male bladders, published his fundamental work showing that a horseshoelike loop surrounds the anterior periphery of the internal vesical os; and that the fibers of this loop continue into the longitudinal fibers of the posterior bladder wall (Figs. 2 and 2A). This seems to be nothing more than Kalischer's trigonal sphincter, or the lisso-sphincter of Waldeyer (Figs. 1 and 1A). (To the striated muscle cover of the urethra was given the name of rhabdo-sphincter.)

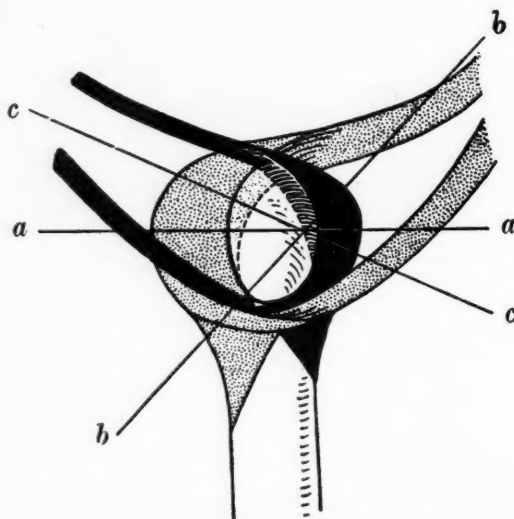


Fig. 1A.—Schematic representation of the double-loop effect. Anterior loop in deep black to the right. Posterior loop in dotted area to the left. The following authors used different planes of sections, as demonstrated by *a—a* (Waldeyer), *b—b* (Kalischer), *c—c* (von Lüdington).

Wesson, independently of Heiss, described the same structure in 1920, and already anticipated partly von Lüdington's work, describing two sphincter-like muscular arrangements in the male, namely, an outer loop about the vesical neck, arising from the longitudinal muscle layer of the bladder, the external arcuate muscle of the vesical os, "*musculus arcuatus externus orificii vesicalis*," and an inner loop arising from the internal circular muscle layer of the bladder, the internal arcuate muscle of the vesical os, "*musculus internus orificii vesicalis*."

Heiss emphasized the importance of the wealth of the submucous venous ramifications, and their role in the closing mechanism, which will be discussed later on. He also considered the bladder muscle as a more or less functional entity of three layers, an outer longitudinal, a middle circular, and an inner longitudinal, which conjointly represent the "detrusor." Only the trigone is implanted like a foreign body. Heiss bases his conception of continence and micturition on the synchronous action of (1) the pubovesical muscles and ligaments, and (2) the sphincteric arrangement, the venous supply acting as a cavernous body.

The important role of the submucosal venous pads in continence and micturition, first emphasized by Heiss, was entirely supported by Stieve. They act

like a cavernous body; that means that they are the ramifications from the richly developed vesical venous plexus, and distention of the bladder leads to a narrowing of the venous lumina in the bladder wall and therefore to a kind of congestion in the capillaries of the venous pads. This brings about an intimate juxtaposition of the urethral mucosal folds or "caulking" of the transverse mucosal fissure at the internal vesical os, and when the bladder contracts, with consequent change of shape, the pressure on the veins in the formerly distended bladder relaxes and therefore a detumescence occurs in the venous pads and mucosal folds, creating additional space for the passing of urine.

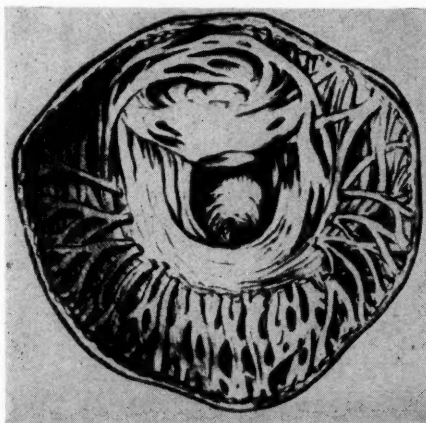


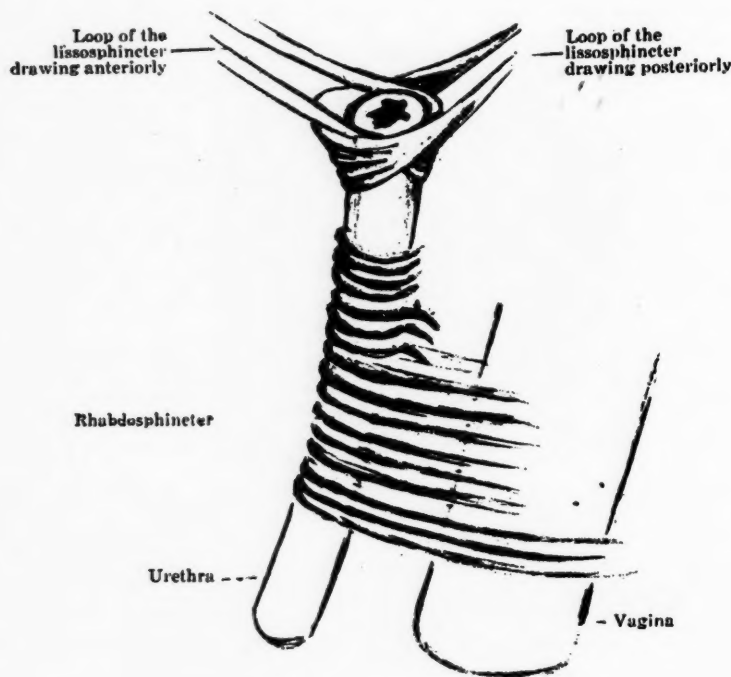
Fig. 2.—The detrusor loop is completely exposed. Both sides of the loop appear as broad bands which disappear beneath the lateral borders of the trigone. The transverse fibers of the trigonal musculature are completely removed.



Fig. 2A.—Own specimen showing Heiss-Wesson anterior loop demarcated by black threads (photographed under the magnifying glass). Other transverse black bar marks posterior periphery of the internal vesical os.

It is also possible that this reflex affects the vasoconstrictor nerves and helps in this way to reduce the venous pads. Von Lüdinghausen, Heiss' pupil, was able to show that after removal of the trigone, another loop covers the Heiss-Wesson

sphincter cranially (Fig. 1A). This is a smaller, more delicate horseshoelike loop, in reverse direction and within the Heiss-Wesson one, the apex lying at the posterior periphery of the internal vesical os, and the fibers passing brush-like into the circular layers anteriorly. The action of both was compared to a "spigot" or "pinchcock" action. Von Lüdinghausen's discovery is best demonstrated in the work of Martius (Fig. 3), which shows clearly the arrangement and the action of the two loops.



**Lissosphincter and rhabdosphincter (diagrammatic)**

Fig. 3.—Diagram to illustrate the position of striated sphincter. The smooth internal sphincter really extends down deep to the upper extremity of the external loop. (Courtesy Professor H. Martius.)

How far the external voluntary muscles can participate in the mechanism of continence is not at all clarified. They seem to be an accessory mechanism, as recent work shows. Boeminghaus (1921) began to approach the problem with the help of x-rays, and pointed out that besides the changing shape of the bladder in filling and voiding, the internal vesical os has to descend almost 1 cm. below its original level in voiding (Fig. 4, C).

This is not only a simple descent but also a displacement posteriorly. Furthermore, the distance between symphysis pubis and bladder wall increases 1 cm. and this leads to a stretching of the pubovesical ligaments and muscles. Thus, the pubovesical structures have not only a suspensory task but also an important function in the opening of the internal vesical os; because they interdigitate with the bladder musculature, i.e., to the periphery of the anterior loop.



Halban's pupil, Paul Schneider, published recently in the *Urologic and Cutaneous Review* a comprehensive résumé on this problem, stressing the operative principles of his venerated teacher.

In England more recent publications by McIntosh Marshall and Jeffcoate have helped to elucidate this intricate mechanism.

On this continent the work on the problem is associated with the names, among others, of Wesson, Counseller, Te Linde, Kennedy, Phaneuf, Hodgkinson, Aldridge, Studdiford, Davis, Van Duzen, Looney, Philpott, and Marchetti.

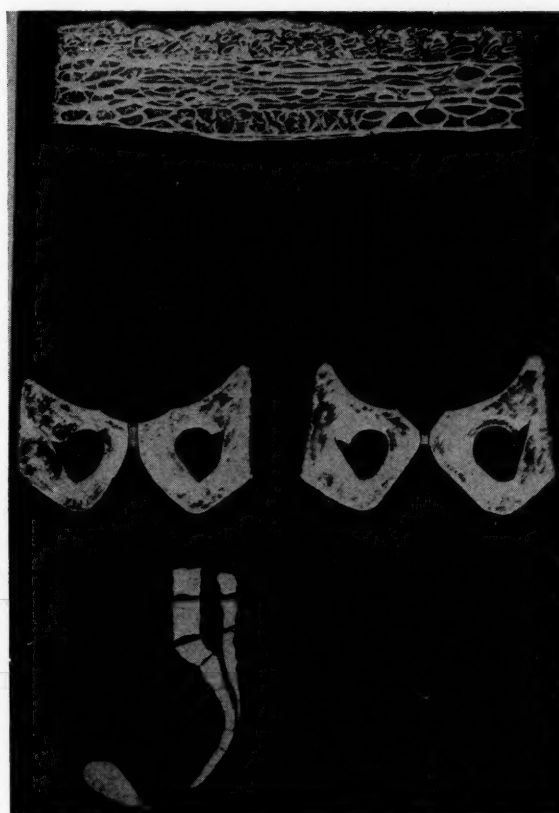


Fig. 4.—A, Section through trigone. B, Filling and voiding. C, Descent of internal vesical orifice in voiding.

Kennedy endeavored to clarify the anatomical and physiological fundamentals of continence and voiding, arriving at the concept of a "muscle of micturition." The structure of the pelvic floor may be recalled, to which I have recently devoted several papers. Suffice it to mention that the fibers of the levator ani may participate in the construction of the urethrovaginal structures and that the voluntary sphincteric group at the outlet originates from the cloacal sphincter and, therefore, has to maintain at least in part its original function.

Kennedy described a distinct and separate muscle of micturition. It is difficult to confirm the existence of this as a separate entity. What Kennedy

described as the muscle of micturition seems to be, in part, the anterior loop of striated muscle described by Zangemeister and Martius.

Kennedy also devoted a considerable amount of work to demonstrating, by means of an x-ray method elaborated by himself, the existence of three urethral sphincters: an outer sphincter on the meatus, a sphincter on the middle part of the urethra, and an internal one. How far the resistance encountered by filling the urethra with a radiopaque substance can be interpreted as a true sphincteric action cannot readily be assessed, for any smooth-muscle tube, for example, the intestinal tract, will oppose distention with spastic reactions that simulate a sphincteric contraction.

Counseller, Davies, and Lowseley endorse the concept of three urethral sphincters.

### Development and Anatomy

When the cloaca becomes divided into the urogenital sinus and rectum, the primordial sphincter divides into two sphincteric muscles from which the anterior one surrounds the urogenital sinus and the posterior one the anus. In the case of the female, this division is clearly evident for there are the sphincter ani and the urogenital diaphragm.

Further muscular elemental derivatives are the transversus perinei superficialis and profundus muscles, "consequently the urogenital diaphragm represents the 'corseting' muscle for the urogenital canal" (Sellheim).

The urogenital diaphragm is composed of the urethrovaginal sphincter and the transversus perinei profundus together with the superior and inferior fascia. The function of the muscles of this diaphragm together with the levator ani muscle is primarily a static one, viz., to carry the pressure of the abdominal viscera when their normal condition of balance becomes disturbed.

The levator ani muscle passes on each side of the urethra, forming a cranial or pelvic and a caudal or perineal part of the urethra.

### Process of Voiding

The shape of the empty bladder, traditionally described as tetrahedric but never assuming such form in the living due to its vital tonus, is, however, determined by three points of attachment or suspension: (1) the pubovesical ligaments and muscles; (2) the urachus; (3) the fixation to the uterus. As the empty bladder is an elastic pouch, the filling of it takes place according to hydrostatic principles. This means that the fluid contents try to reach the lowest point according to the law of gravity, and their fluid level remains always horizontal. This explains the extension of the bladder in transverse direction during the process of filling. If the bladder is full, a reflex occurs in the bladder wall—representing somewhat an irregular cone—and it passes from the state of distention to the state of contraction. The consequence is a change in shape of the bladder from a cone to an ovoid (Fig. 4, B). The muscle pressure, plus the weight of the fluid contents, finds a point of lower resistance at the funnel-shaped internal vesical os, which latter is synchronously pressed downward and backward. The fluid pressed into the urethra brings forth the relaxation of the

"spigot" action of both sphincteric loops, and simultaneously, decongestion, or detumescence of the submucous venous pads. Under the pressure of the out-streaming urine, the accessory muscular arrangements and covers of the urethral canal relax, and the posterior urethral wall slides forward by synchronous shortening of the urethral canal. When the fluid contents are expelled, the original muscular tonus is re-established in all participating elements. The posterior urethral wall slides back, the urethral canal returns to its previous length, the venous pads become filled, the spigot action of the sphincteric loops comes into play, and the internal vesical os returns to its original level.

### **The Control of the Bladder**

It seems that in the published works of the various authors one point is not sufficiently emphasized, viz., the definition of the concept of control.

There are two types of control, involuntary and voluntary; the involuntary control is limited exclusively to the smooth muscles and the voluntary, of course, to the striated ones. As already mentioned, the sphincteric muscle arrangements for the urogenital sinus and the anus are derived from the sphincter cloacae, and it would be indeed contrary to the original sphincteric task, viz., "a closer mechanism," to assume that in extrauterine life a switch to an opening mechanism has taken place, in other words "the lock would become the key." That would be an evolutionary contradiction. Furthermore, any mammal or child is automatically continent as a result of the automatic control of the hollow viscus and its contents (physiological tonus) up to the time that the voiding reflex is enacted.

In the case of man, the striated muscles on the urethrovaginal tube cannot be supposed to change their function to a relaxing mechanism for the release of the contents of the viscus. Their role can therefore be only a passive one, i.e., to restore the original condition following the changes occurring in the act of expulsion of the contents of the viscus. Neither can an accessory active role be proved or denied.

The active control preventing the escape of viscus contents under normal conditions has to be exerted by means of a more powerful arrangement of striated muscle, viz., the action of the levator ani muscle and the external striated sphincter (i.e., sphincter vulvae group). The evidence that the internal vesical os is displaced downward and backward at the initiation of the act of micturition shows on the other hand that the relaxation of the levator ani muscle is indispensable for the physiological passing of urine.

### **Material and Method**

Material consisted of the following: fourteen female bladders, four of which were complete with vulva, and one term bladder, four male bladders, four children's bladders (female), and a number of fetal specimens. Some of the bladders were filled with wax, others with 10 per cent formalin, the injected material being introduced through the ureters. Dissection was done under the magnifying glass, the tissues being dissected with fine Graefe corneal scalpels or teased out with needles.

### Results

The first object was to demonstrate, by gross dissection, the fibers described on the urethra (by Zangemeister); this proved to be impossible because no differentiation could be made between smooth and striated muscle. A sphincteric arrangement around the external meatus could be clearly dissected. In some specimens one could verify the existence of three sphincteric muscles surrounding the urethra as described by Kennedy: a lower and middle sphincter formed

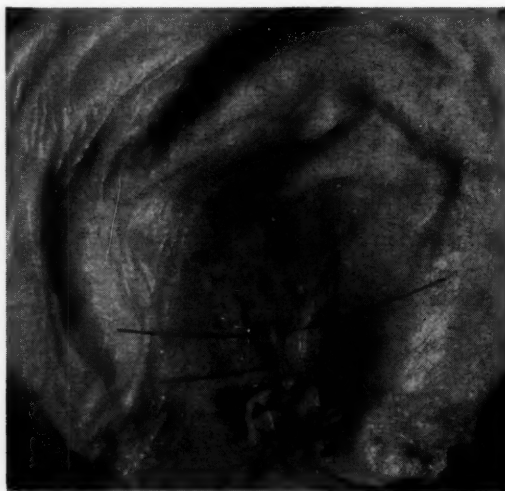


Fig. 5.—Female bladder. The mucosa from the trigone is dissected and the retractor uvulae muscle is exposed by two underlying horse hairs.

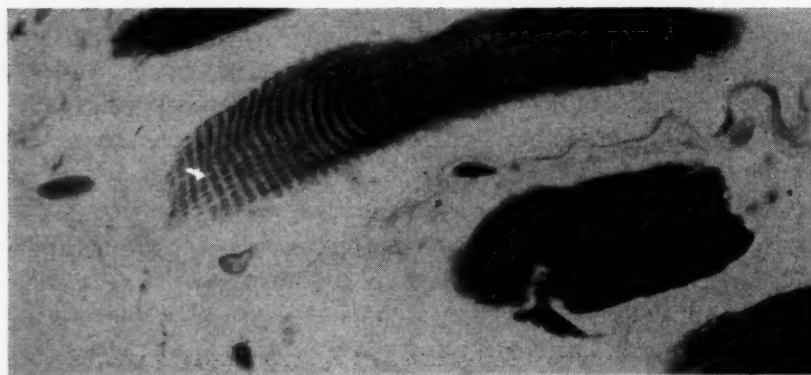


Fig. 5A.—Iron-hematoxylin stain showing striated muscle fibers in the retractor uvulae muscle. ( $\times 150$ ; reduced  $\frac{1}{4}$ .)

of striated muscle corresponding to the outer sphincter described by Zangemeister, an upper and inner sphincter which is *smooth* muscle (Figs 1, 1A, 2, and 2A). The two former sphincters are simply thickenings or condensations of the external striated sphincter and are *not* separate entities. These condensations are most evident in parous women, and they may arise as a result of mild trauma or strain. In 50 per cent of the female bladders examined, a distinct uvula on the vesical os was found in all bladders. The so-called “re-



tractor uvulae" was histologically examined. The name uvula is misleading. The structure is really a crescentic ridge, presenting no resemblance to the uvula of the soft palate.

The first specimen showed striated fibers in the retractor uvulae (Figs. 5 and 5A). A review of the literature showed that McCrea in 1926 had already noted the same occasional finding. As the other retractor uvulae showed no striated fibers, this finding was considered incidental.

The mucosa is readily denuded except over the trigone, where mucosa and underlying tissue blend intimately and render its removal quite difficult. Over the rest of the bladder the mucosa is separated from the muscle by loose areolar tissue which permits extensive distention of the bladder. These facts are functionally important. The trigone does not participate in the distention nor does it possess any submucosal areolar tissue (Fig. 4A). The trigone itself impresses one as a dense felt, contrasting with the trabeculated arrangement of the bladder wall, and therefore seems to be implanted like a foreign body in the bladder.



Fig. 6.—Venetian-blind-like structure of the trigone. Transverse ridges in the trigone are separated by black threads, the ureteric openings are marked by pinheads.

The bladder is an ovoid standing on a triangular base, the trigone, which latter is inelastic and nondistensible. As concerns development, the bladder proper develops from the "pars pelvica" of the urogenital sinus, whereas the trigone apparently represents the absorbed caudal ends of the Wolffian ducts and ureteric buds.

We may speak of cloacogenic and allantoigenic bladders. It must be pointed out that the bladder derived from the cloaca may be formed from either its dorsal or its ventral wall and we must therefore distinguish between dorso-cloacogenic and ventro-cloacogenic bladders. The amphibia possess purely ventro-cloacogenic bladders; a purely allantoigenic bladder occurs temporarily in some birds; a purely mesodermal bladder is developed in the selaceans. Mam-

mals have bladders of cloacogenic and mesodermal origin. In man also a ventro-cloacogenic and mesodermal bladder develops; an allantoigenic origin—formerly supposed—does not exist.

The ureters bud out as metanephric ducts from the mesonephric (Wolffian) ducts. In further course of development the two openings of the metanephric ducts (the later ureters) are moved cranially and laterally, whereas those of the Wolffian ducts remain fixed. Thereby a triangular plate, apparently of mesodermal origin, arises on the posterior wall of the urogenital sinus. This plate becomes the trigone of the bladder and the posterior wall of the urethra down to the opening of the ejaculatory ducts. In the female, it is at present unknown how far down this plate extends, but it probably involves the whole posterior wall of the urethra.

The trigone seems to be built up like a Venetian blind in several layers which overlap each other from below upward, when viewed from the bladder. Five such layers are shown in Fig. 6. The number of layers may vary. The Venetian-blind-like development illustrates the developmental concept of the rising of the ureteric openings. The boundaries of the trigone are derived from the continuation of the ureteric sheath which enters into intimate structural connection with the bladder wall proper by penetrating it. The muscular part of the ureters continues into the trigone, forming the lateral boundary of the trigone, or Bell's muscle. This also would suggest a facile explanation of the parallel and synchronous development of Bell's muscles with the trigone.

No direct active control of the outflow of urine can be exerted on the part of the muscles of the sphincteric group under normal conditions; only the intramural, i.e., intravesical, part of the urethra, with its two sphincteric loops, with its venous pads, with its smooth-muscle arrangements as the direct continuation of the trigone, represents the lock for the maintenance of continence under physiological conditions. These are as follows, viz., that the suspensory ligaments and muscles (pubovesical) are not overstretched, the physiological muscle tonus of the participating structures is preserved, and that the backward and downward shifting of the internal vesical os and its return to the physiological level are granted. It seems on the basis of x-ray evidence that this shifting of the internal vesical os is the key point for the maintenance of continence and the initiation of micturition, and that the shifting and its return can be enacted only by relaxation and later on by contraction of the levator ani muscle. All mammals have to assume a relaxed position for the passing of urine. Contraction of the levator ani muscle interrupts the flow of urine, because the internal vesical os is lifted up to its physiological level, where the smooth-muscle sphincters automatically close the internal vesical os.

Voluntary contraction of the levator ani muscle is effected through the third and fourth sacral and the perineal branch of the pudendal nerve. According to Kennedy, the latter nerve also supplies the muscle of micturition. It is unlikely that this not clearly demarcated muscle can be stimulated alone. The effects attributed to its stimulation are probably due to a concomitant stimulation of the levator muscle. Again it should be emphasized that, on evolutionary grounds, a sphincteric anlage cannot switch to the contrary.

### Summary

On the basis of presented evidence, it appears that maintenance of continence and the process of micturition are the result of an intricate, synchronously and synergetically acting mechanism. This latter depends upon: (1) the sphincteric loops (Heiss, Wesson, von Lüdinghausen), (2) the integrity of the sling-shot-like arrangement of the trigonal fibers continuing into the urethra, (3) the integrity of the pubovesical ligaments and muscles, (4) the action of the submucous venous pads, (5) the integrity of the nerve tracts, and (6) doubtless primarily upon the integrity of the pelvic floor.

1. The striated musculature covering the perineal part of the urethra is a derivative of the sphincter cloacae and, therefore, on evolutionary grounds, must exert a sphincteric function.

2. The levator ani muscle seems to play an important role in the act of micturition and in the condition of continence.

3. The displacement downward and backward of the internal vesical os initiates the act of micturition. The levator ani muscle is the principal agent in controlling this movement.

4. Only the intramural part of the urethra participates directly and automatically in the normal closure and voiding mechanism.

5. Normal continence is maintained by the involuntary tone of the groups and a normally functioning levator ani muscle.

*Stress incontinence* is due to a momentary downward and backward displacement of the bladder which relaxes the smooth-muscle sphincters by tension on the pubovesical muscles.

*Dribbling incontinence* may be due to (a) a permanent downward and backward displacement of the bladder, or (b) trauma to the smooth sphincteric muscles, or (c) possibly shortening of the pubovesical muscle, or (d) it may be of nervous origin.

If any muscle has the right to the title of "muscle of micturition," it seems to be the levator ani muscle. The striated sphincter at the lower end of the urethra and derived from the sphincter cloacae is probably used only through an effort at voluntary control when the involuntary mechanism has broken down.

6. The levator ani muscle brought into action in the case of voluntary restraint receives its stimulus partly over the pudendal nerve. It is therefore conceivable that the ramifications of the pudendal nerve receive for their part simultaneous stimuli and that, correspondingly, the muscles of the sphincteric group, supplied by those ramifications, produce an accessory corseting of the urethrovaginal tube.

7. In conclusion, in brief, the urethra is constructed on somewhat similar lines to the anal canal. There is an internal sphincteric arrangement formed of smooth muscle which is especially developed at the cranial end; outside this there is an external sphincteric arrangement of striated muscle which is especially developed at the caudal end.

I wish to express my appreciation to Professor C. P. Martin, Department of Anatomy, McGill University, for his constructive criticism in the anatomical description of this paper, and for preserved adult female viscera. To the following my thanks are due for fresh dissection material used in the preparation of this work: Professors G. Lyman Duff, of the Pathological Institute, McGill University, and Jos. E. Pritchard, Pathologist, Montreal General Hospital; Drs. F. W. Wigglesworth, Pathologist, Children's Memorial Hospital; M. A. Simon, Pathologist, Jewish General Hospital; T. Richardson, Pathologist, St. Mary's Hospital, and Jean Marie Roussel, Provincial Medicolegal Expert.

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## Original Communications

### AN ANALYSIS OF 1,146 CASES OF INTERNAL PODALIC VERSION AND EXTRACTION\*

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WE FIND ourselves in the unique position of advocating a procedure which is in disrepute in most of the country and the use of which is declining in our own institution. This report is a continuation of a study made a few years ago when an analysis of 534 patients delivered by internal podalic version and extraction was reported.<sup>1</sup> The conclusions at that time were (1) the procedure should not be performed routinely, but (2) that many cases of inertia, failure of descent, transverse arrest, and persistent posterior are best managed by version and extraction. With our series now increased by 612, making a total of 1,146 cases, we wish to evaluate the present status of internal podalic version and extraction and see if our former conclusions are justified. In other words, is internal podalic version and extraction worthy of remaining an integral part of our obstetric armamentarium or should it be discarded like symphysiotomy, pubiotomy, bougie induction of labor, etc.?

#### Material Studied

The 1,146 versions and extractions were performed at the Elizabeth Steel Magee Hospital over the period of 8 years from Jan. 1, 1944, to Jan. 1, 1952. During this time there were 38,871 labors, making the incidence of versions 2.95 per cent, or one in every 34 patients delivered. Only 45 of the versions were performed on the second of twins and two babies of a set of triplets were delivered in this way. This percentage compares with reports of other authors of an incidence ranging from 1.03 per cent to 4.7 per cent. The largest of these other series comprised only 445 cases (Table I).

Private patients accounted for 1,031 versions and 115 were done on the ward service. Obstetricians performed 1,038 of the versions (including 82 in consultation); residents, 128; men predominately gynecologists, 46; and 62 were performed by courtesy staff members qualified to do operative obstetrics.

#### Age, Parity, and Term of Gestation

Ages of the patients varied between 16 and 43 (Table II). Primigravidas, or patients with previous abortions only, accounted for 576 of the cases,

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\*\*Present address, 18664 Dixie Highway, Homewood, Ill.

while 570 were multigravidas. Gravidity went up as high as 17 (Table III). The duration of gestation was at least 4½ months in all cases (Table IV).

TABLE I. REPORTED SERIES OF CASES OF INTERNAL PODALIC VERSION

YEAR	AUTHOR	NO. VERSIONS	INCIDENCE (%)	MATERNAL MORTALITY		FETAL MORTALITY	
				NO.	%	GROSS	CORRECTED
1930	Reeves <sup>5</sup>	154	3.0	1			3.2
1932	Potter <sup>6</sup>						2.3
1932	Baer <sup>4</sup>	156	1.03			17.2	10.2
1936	Rosenfeld <sup>7</sup>	120				9.1	3.3
1937	LaVake <sup>8</sup>	76	4.7				8.05
1940	Miller <sup>12</sup>	76				32.8	
1940	Cosgrove <sup>9</sup>	221		2	1.1	30.8	
1940	Martin <sup>14</sup>	38		2	5.2	39.4	
1941	Reddock <sup>10</sup>	370	1.14	7	1.98	27.3	23.8
1946	Speiser <sup>11</sup>	21				57.1	38.0
1947	Assali <sup>13</sup>	120		2	1.6	38.7	
1949	Erving <sup>1</sup>	534	4.1	1	0.18	5.8	2.6
1951	Jarrett <sup>3</sup>	445	2.12			3.8	2.2

TABLE II. AGE DISTRIBUTION

AGE GROUPS (YEARS)	16-19	20-29	30-39	40-43
No. of cases	44	646	425	31

TABLE III. DISTRIBUTION BY GRAVIDITY

GRAVIDA	i	ii	iii	iv	v	vi	vii	viii	ix	xi	xii	xiii	xiv	xvii
No. of cases	576	282	164	58	22	16	10	8	3	2	2	1	1	1

TABLE IV. TERM OF GESTATION

MONTHS	4½-5	5-6	6-7	7-8	8-9	9	9 PLUS
No. of cases	2	2	4	22	160	862	94

### Indications

Fifteen different indications were given for performing internal podalic version and extraction. The group composed of inertia, persistent posterior, transverse arrest, and failure of descent made up by far the largest number (750, or 65.4 per cent). As these are complementary reasons, the one listed first on the record has been selected as the prime indication. "Prophylactic" version was performed in 236 instances including 45 second twins and 2 triplets. Fetal distress and/or prolapsed cord accounted for the only other sizable group, namely, 56 cases. The other indications are shown in Table V.

There were 49 successful versions after failed forceps. This is in direct rebuttal to Decker, Dickson, and Heaton,<sup>18</sup> who state, "When forceps fail there is little reason to believe that a live, uninjured baby can be obtained by version and extraction." This statement was made in their recent analysis of 547 midforceps operations. It is pertinent to note that their corrected fetal mortality was 4.75 per cent as compared to 2.7 per cent in this report.

Sixty-eight patients had a history of a previous version, 3 had had two previous versions, and 2 had had three previous versions.

TABLE V. INDICATIONS FOR VERSION

INDICATIONS	NUMBER	MATERNAL DEATHS		FETAL DEATHS NUMBER
		NUMBER	PERCENTAGE	
Inertia	347	1	0.45	20
Persistent posterior	202			4
Transverse arrest	107			7
Failure of descent	94			4
Prophylactic	236			6
Fetal distress or pro- lapsed cord	56			9
Relative disproportion	35			0
Transverse presentation	25			1
Premature separation of placenta	16			7
Face presentation	13			1
Abnormalities	5			0
Placenta previa	3			1
Toxemia	3			1
Hydrocephalus	2			2
Prolapsed hand	2			0
Total				63

### Duration of Labor

The duration of labor varied from a few hours, in many of the prophylactic cases, to 150 hours. Nineteen patients had no recorded duration of labor (Table VI).

TABLE VI. DURATION OF LABOR

HOURS	ALL CASES	PRIMIPARAS	MULTIPARAS
12 or less	495	148	347
13-18	242	127	115
19-40	308	238	70
41-60	66	57	9
61-80	9	4	5
81-100	4	4	0
100-150	3	2	1
Unknown	19	9	10

TABLE VII. RUPTURED MEMBRANES

HOURS	NO. OF CASES
½-2	130
3-5	85
6-10	93
11-20	102
21-35	54
36-50	24
51-75	17
76-100	6
100+	4
Unknown	43

### Ruptured Membranes

The membranes were known to be intact at the time of delivery in only 588 instances. In 43 there is no record. In the remaining 515 cases the membranes were ruptured from one-half hour to five days prior to the performance of the internal podalic version (Table VII). This simply indicates that the

status of the membranes is without significance provided the head can be readily displaced from the pelvic inlet. Adequate anesthesia is the prime requisite.

### Complications of Delivery

These are shown in Table VIII. The incidence of third-degree lacerations is far higher than it should be, for one of the contraindications to median episiotomy is an internal podalic version and extraction. It is unusual to find so few cases of manual removal of the placenta, as exploration of the uterus following version should be almost routine, and for repair of sulcus and cervical lacerations the absence of the placenta is helpful in exposing the field. The occurrence of only one ruptured uterus in the series is evidence that this need not be a common complication as Cosgrove and his associates<sup>9</sup> indicate with their incidence of 1 rupture in every 77 versions. It also casts doubt on the presence of a Bandl's ring as reported on the charts in 42 cases. Obviously a true Bandl's ring will not permit a version to be performed. These must have been exaggerated physiological retraction rings which relaxed under anesthesia.

TABLE VIII. COMPLICATIONS OF DELIVERY

Second-degree laceration of perineum	187
Third-degree laceration of perineum	11
Manual removal of placenta	159
Sulcus lacerations	86
Cervical lacerations	79
Bandl's ring	42
Nuchal arm	4
Rupture of uterus	1
Packing of uterus	61
Plasma transfusions	29
Blood transfusions	25
Manual dilatation of cervix	10
Voorhees bag	3
Dührssen's incisions	1

### Postpartum Complications

There were no unusual postpartum complications although the incidence of pulmonary disorders is high. This may be attributed to the fact that deep anesthesia is required for performing a version.

TABLE IX. POSTPARTUM COMPLICATIONS

Endometritis	40
Retained placental tissue	17
Acute mastitis or breast abscess	9
Pyelitis	4
Thrombophlebitis	4
Bronchitis, atelectasis, pneumonia, and pulmonary edema	15

One thousand two patients remained in the hospital 12 days or less; 112 between 13 and 15 days, and 32 for a longer period. A large percentage of those patients remaining 12 days or over were afebrile. The longest period of hospitalization was 29 days for a patient with a thrombophlebitis of the left leg.



### Maternal Mortality

There was one maternal death (0.09 per cent) in the series. This patient, a 26-year-old primigravida, was admitted to the hospital in weak labor one week after her estimated date of confinement. After nine hours of labor the membranes were ruptured artificially, but the labor pains continued inertial in type. Thirty-six hours after the onset of labor the cervix was completely dilated, and the baby was in a left occipitoposterior position. A fairly difficult version and extraction were performed, with delivery of a 7 pound, 12 ounce infant. The patient never fully aroused from the anesthetic, being markedly cyanotic. A medical consultant found moist râles and bronchial breathing in both lung bases, and diagnosed the condition as pulmonary atelectasis. The uterus remained firm, and there was no evidence of hemorrhage. Three and one-half hours after delivery the patient had a complete circulatory collapse and died. Permission for an autopsy could not be obtained. The infant died 18 hours after delivery from a probable intracranial hemorrhage.

### Fetal Statistics and Mortality

There were 1,147 infants whose weights are shown in Table X. The largest weighed 12 pounds, 3 ounces.

TABLE X. WEIGHTS OF INFANTS

WEIGHT IN POUNDS	0-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12+
No. of cases	9	8	36	84	235	403	276	83	9	3	1

Sixty-three babies were lost (Table XI). Thirty-one of these were still-born and 32 died in the neonatal period. This is a gross fetal mortality rate of 5.5 per cent. There were 13 monstrosities, 6 nonviable infants (under 3 pounds), and 4 macerated fetuses. In 5 cases of prolapsed cord resulting in stillbirths fetal heart sounds were not heard prior to delivery, and in a case of separation of the placenta the baby was delivered by version prophylactically after the placenta had been expelled. Placental insufficiency, adrenal necrosis of Haas, and erythroblastosis each accounted for one death. Thus

TABLE XI. CAUSES OF FETAL MORTALITY

Nonviable	6
Gross abnormalities	13
Macerated	4
Prolapsed cord	5
Intracranial hemorrhage	16
Atelectasis	2
Erythroblastosis	1
Separation of placenta	2
Prematurity	7
Prematurity and toxemia	1
Prematurity and placenta previa	1
Prematurity and sclerema	1
Unexplained	3
Adrenal necrosis of Haas	1

the type of delivery was of no significance in these 32 deaths and accordingly the corrected fetal mortality rate is 2.7 per cent.

The 16 fetal deaths due to proved or presumed intracranial hemorrhage are probably attributable to the method of delivery. Also, since premature infants tolerate any undue handling very poorly, it is fair to suppose that the type of delivery was contributory to the deaths attributed to prematurity of the 10 infants all under 5 pounds in weight. The same may be true of the two with postmortem findings of atelectasis only. Besides fatal injuries there were 10 infants with fractured clavicles, 3 with fractured humeri, 6 with brachial paralysis, 2 with facial paralysis, 1 with a fractured femur, and 3 with suspected intracranial hemorrhage. As far as is known, none of these resulted in permanent injury or damage, all 3 of the intracranial hemorrhage cases having been followed.

### Discussion

The incidence of internal podalic version at the Elizabeth Steel Magee Hospital is decreasing. For the first 3½ years of this series the incidence was 4.1 per cent compared to 2.4 per cent in the last 4½ years. The probable explanation is that the number of deliveries annually has increased by about one-third, and the younger members of the staff are not as experienced in the art of version. Jarrett<sup>3</sup> reported a similar drop in incidence. Is this perhaps a fault of the teachers of obstetrics? Although opposed to routine versions, we feel a corrected fetal mortality rate of 2.7 per cent in the handling of the obstetric problems of persistent posterior, inertia, failure of descent, face presentation, etc., is comparable with that of any other method of treatment. Schmitz and associates<sup>19</sup> reported a corrected fetal mortality rate of 6.7 per cent in a series of 224 cases of prolonged labor treated ultraconservatively (only 3 versions). Miller,<sup>12</sup> Martin,<sup>14</sup> Assali,<sup>13</sup> and Decker and co-workers<sup>18</sup> reported fetal mortalities of 5 per cent, 8.7 per cent, 4.6 per cent, and 4.75 per cent, respectively, with the use of midforceps, while high forceps is a thing of the past with its resulting high fetal and also maternal mortality. Rudolph<sup>15</sup> feels that place of version in face presentation is lessening, while Reddoch<sup>16</sup> goes to the extreme of claiming that version and extraction have no place in the handling of face presentations. It will be noted that 12 of our 13 face presentations in this series were terminated successfully by version.

One maternal death and one ruptured uterus occurred in this series. We feel the reported high incidence of ruptured uterus (Delfs and Eastman,<sup>2</sup> 1 in 80; Cosgrove and co-workers,<sup>9</sup> 1 in 77) and high maternal mortality rate (Reddoch,<sup>10</sup> 2 per cent; Martin,<sup>14</sup> 5.2 per cent) are due to poor selection of cases and unskilled operators, and should not serve to condemn the procedure of internal podalic version and extraction. We cannot agree with Bowen's<sup>17</sup> opinion that version is one of the most dangerous procedures that can be performed on a parturient female.

Internal podalic version and extraction should not be attempted unless all of the following conditions are present:

1. Completely effaced and dilatable cervix.
2. A displaceable head.
3. Absence of true cephalopelvic disproportion.
4. Adequate anesthesia.
5. An experienced operator.

If performed in the absence of any of the prerequisites or if any contraindications are present such as previous cesarean section, deep myomectomy, or placenta previa, complications are to be anticipated.

### Conclusions

1. Internal podalic version and extraction should not be performed routinely.
2. Many cases of inertia, failure of descent, persistent posterior, transverse arrest, fetal distress, prolapsed cord, and face presentation are best terminated by version and extraction.
3. Displaceability of the head and not length of labor or time of rupture of membranes is the chief criterion as to the possibility of performing a version.
4. Posterolateral and not median episiotomies should be performed.
5. Deep anesthesia, gentleness, and lack of haste are most important.
6. Internal podalic version and extraction have a definite place in the armamentarium of the well-trained obstetrician and involve a minimum of risk to mother and baby in properly selected cases.

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## CERVICAL INCISIONS IN OBSTETRICS

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SINCE Alfred Dührssen,<sup>1</sup> in 1890, set forth his experience with multiple cervical incisions to facilitate termination of certain complicated labors, this procedure has been controversial. Although incision of the cervix to complete the first stage of labor is an operation that readily lends itself to abuse, it now appears to be established as a valuable adjunct to the obstetrician's therapeutic armamentarium.<sup>2, 3, 4</sup>

When exigent developments during labor demand termination in order to safeguard the life of the baby or the mother or both, the decision to accomplish delivery from below or above must be individualized. Certainly, cesarean section is not the logical solution to every complication of labor. Although antibiotics, availability of whole blood, improved anesthesia and operative techniques have reduced the attendant dangers, cesarean section still contributes significantly to maternal morbidity and mortality. In selected instances wherein no fetopelvic disproportion or other obstructive factors exist, incisions of the cervix with delivery from below may well entail less hazard to both mother and infant. Furthermore, incision of the cervix may jeopardize the mother's future obstetrical experiences to a lesser degree than is likely to be the case with abdominal delivery.

During the seventeen-year period covered by this report, completion of the first stage of labor by incising the cervix was carried out in only 84, or 0.66 per cent, of a total of 12,760 deliveries (Table I). Three patients in whom a single incision was made in the posterior cervix after delivery of the shoulders during breech extractions were not included in this series.

TABLE I. INCIDENCE OF CERVICAL INCISIONS

DATE	TOTAL DELIVERIES	INCISIONS	PERCENTAGE
1935-1939	2,776	13	0.47
1940-1944	2,498	14	0.56
1945-1949	3,890	33	0.85
1950-1952	3,596	24	0.67
Total	12,760	84	0.66

The technique utilized in this series did not differ appreciably from that employed in most other reported series during the past two decades. Following a deep mediolateral episiotomy to facilitate exposure of the cervix and subsequent delivery, the cervix was grasped with sponge forceps and incisions made at 10, 2, and 6 o'clock under direct visualization. The posterior or 6 o'clock incision was generally made first, since this area may be obscured to



some extent by bleeding from an anterior incision. Also, if the anterior incisions are made first, the posterior cervix may retract out of reach. On occasion, one or two incisions suffice, depending upon the station and degree of dilatation. The maximum number of incisions (3) is usually preferable, minimizing the chances of extension of the incision during the course of delivery.

The optimum conditions under which incisions may be performed are: (1) complete effacement of the cervix, (2) ruptured membranes, (3) more than 5 cm. cervical dilatation, (4) the presenting part at a station below the level of the ischial spines, and (5) an adequate maternal pelvis.

### Special Indications

There was seldom a single indication for this procedure (Table II). In contrast with the indications in other series, cephalopelvic disproportion was considered a contraindication. In retrospect relative disproportion was thought to have contributed to the dystocia in only seven of these patients. Absolute disproportion was ruled out by sterile pelvic examination and manual mensuration supplemented by intrapartum roentgenography in four of the seven.

TABLE II. INDICATIONS FOR CERVICAL INCISIONS

YEAR	NO.	DISPRO- PORTION	PRO- LONGED LABOR	ARREST OF PROG- RESS	DEPRESSED FETAL HEART TONES	PRO- LAPSED CORD	INTRA- PARTUM BLEEDING	MA- TERNAL DISEASE
1935-1939	13	0	11	1	—	—	—	—
1940-1944	14	0	11	2	—	1	—	—
1945-1949	33	0	20	10	—	2	2	—
1950-1952	24	0	9	10	3	—	—	2
Total	84	0	51	23	3	3	2	2
Percentage	100	0	60.72	27.38	3.57	3.57	2.38	2.38

Based on the arbitrary criteria of 18 hours of active labor for multiparas and 24 hours for primiparas, 60.72 per cent had prolonged labors. Past observations of the significant increase in fetal mortality rates after 24 hours of active labor undoubtedly were influential in the decisions relating to the termination of some of these labors.<sup>5</sup> Since time per se is not of major importance in assessing a labor, this factor alone did not constitute an indication for termination. Rather, the pattern of progress, quality of uterine contractions, the period of time the fetal head was deep in the pelvis during labor, fetal heart tones, maternal exhaustion and concurrent disease, failure of response to rest, fluids, antibiotics were, in combination, major considerations. An arrest of progress for four or more hours occurred in 27.38 per cent. In three, or 3.5 per cent, sustained depression of the fetal heart rate below 80 per minute constituted a primary indication. Irregularity of the fetal heart alone did not serve as an indication. Such a criterion is notoriously unreliable in view of the wide fluctuation of the fetal heart in normal infants during labor and interference on this basis may result in added fetal trauma rather than benefit.

In three cases prolapse of the umbilical cord was the sole indication. Intrapartum bleeding prompted termination of labor in two. One had a partial abruptio placentae. The other was a multipara at 30 weeks of gestation with massive antepartum hemorrhage and deep shock from a partial placenta previa. Logically placenta previa constitutes a contraindication to cervical incisions since cutting into the placental bed invites uncontrollable hemorrhage. In this instance, the patient had no perceptible pulse or blood pressure and it was felt that her condition at the time precluded an abdominal approach. The bleeding was stanching by an intraovular bag initially inserted through a 3 cm. dilated cervix. At 6 cm. dilatation delivery was accomplished after three incisions of the cervix.

Maternal disease was the precipitating factor in two cases. One patient had severe rheumatic heart disease with arrest of progress in labor. The other had pre-eclampsia with progressive deterioration of the maternal condition after a prolonged labor and arrest of cervical dilatation.

Other pregnancy complications in this series are of interest (Table III). Almost one out of four patients was obese and a similar number had some psychiatric problem recognized antenatally. For the most part these two categories involved the primigravidas with prolonged labors. The 13 per cent toxemia incidence is largely what might be expected with the 88 per cent incidence of primiparas (Table IV) and since all of these patients were derived from a group with major maternal and/or fetal complications. Myomas were recognized in only 5.9 per cent. Myomas did not cause obstruction in any but may have contributed to the prolonged labors which occurred in four of these five patients. Signs of intrapartum infection appeared in 10.7 per cent. The majority of these fell into the era prior to the advent of antibiotics. The pattern of labor was characteristic of primary inertia in 58.3 per cent and secondary inertia in 27.3 per cent.

TABLE III. OTHER PREGNANCY COMPLICATIONS

AGE (YEARS)	NO.	OBESE	PSYCHIC FACTORS	TOXEMIA	MYOMAS	INFECTION (INTRA- PARTUM)	PRIMARY INERTIA	SEC- ONDARY INERTIA
15-19	4	1	1	0	0	1	2	0
20-24	20	5	7	4	0	2	10	8
25-29	39	10	7	1	2	3	25	10
30-34	12	2	2	5	1	1	5	4
35-39	6	1	2	1	1	1	4	1
40-44	3	1	0	0	1	1	3	0
Total	84	20	19	11	5	9	49	23
Percentage	100	23.4	22.6	13.1	5.9	10.7	58.3	27.3

TABLE IV. PARITY

	NO.	PERCENTAGE
Primiparas	74	88
Multiparas	10	12

There was no statistically significant difference in the incidence of artificial induction of labor in the incisions series (Table V, A) and in those labors without incisions (Table V, B).

TABLE V. INDUCTION OF LABOR

	NO.	PERCENTAGE
<i>A. Incisions Series.—</i>		
Spontaneous	74	88.1
Artificial	10	11.9
<i>B. Without Incisions.—</i>		
Spontaneous	11,606	91.5
Artificial	1,007	8.5

Among the primiparas 47, or 56 per cent of the total series, had labors in excess of 24 hours (Table VI). The majority in this group had cervical incisions because of complications, both maternal and fetal, more commonly associated with prolonged labors. Only two multiparas had labors longer than 24 hours. Eight of the ten multiparas developed complications largely independent of prolonged labors, e.g., intrapartum bleeding, maternal disease, prolapse of the umbilical cord.

TABLE VI. DURATION OF LABOR

HOURS	PRIMIPARAS		MULTIPARAS	
	NO.	PERCENTAGE	NO.	PERCENTAGE
0-24	27	32.1	8	9.5
25-49	33	39.3	2	2.4
50-74	9	10.7		
Over 74	5	6		
Over 24	47	56	2	2.4

The less the cervix is dilated and the higher the station of the presenting part, the greater is the hazard of operative delivery from below. In only two patients the presenting fetal part was above the ischial spines. Cervical incisions and operative deliveries from these levels are not to be condoned, for currently abdominal section would be safer in most instances. One of these patients was the multipara with placenta previa previously described in detail. The other was a multipara with 9 cm. cervical dilatation and arrest of progress for 10 hours with depression of the fetal heart. In only six was the station zero and in 90.5 per cent the station was plus one or lower (Table VII).

TABLE VII. DILATATION AND STATION AT TIME OF INCISIONS

DILATATION	NO.	STATION				
		-1	0	+1	+2	+3
4-5 cm.	8	1	1	1	5	0
6-7 cm.	13	0	2	3	7	1
8-9 cm.	63	1	3	8	31	20

Occipitoposterior positions contributed significantly to the complications in these labors. At the time of the initial examination in labor 35, or 41.6 per cent, had posterior positions. Twenty-seven, or 32.1 per cent, had persistent occipitoposterior positions at the time of cervical incisions (Table VIII). Forty-six and four-tenths per cent were in an anterior position by the time the cervix was incised. Almost 17 per cent were in the transverse. The number of breeches did not differ statistically from the normal incidence since one was a premature infant and another the second of twins.

TABLE VIII. FETAL POSITION

	NO.	PERCENTAGE
Occiput anterior	39	46.4
Occiput transverse	14	16.7
Occiput posterior	27	32.1
Breech presentation	4	4.8

**Special Points in Technique**

Operative rotation of the fetal head following cervical incisions increases the potential danger of extension of the incisions as well as fetal trauma. In 38, or 46 per cent, manual rotation (6 per cent) or forceps rotation (40 per cent) was carried out (Table IX). No rotation was done in 46, or 54 per cent.

TABLE IX. ROTATION AFTER INCISIONS

	NO.	PERCENTAGE
Manual	5	6
Forceps	33	40
No rotation	46	54

Low forceps delivery occurred in 53, or 61.6 per cent (Table X). Midforceps delivery which must be considered a hazardous operation, especially from the standpoint of the fetus, was utilized in almost one-third. High forceps delivery with the head engaged occurred in one and there were four breech extractions.

TABLE X. TYPE OF DELIVERY

	NO.	PERCENTAGE
Low forceps	53	61.6
Midforceps	28	32.6
High forceps	1	1.2
Breech extraction	4	4.6
Total	86 (4 twins)	100.0

Notoriously, repair of cervical lacerations or incisions is attended by a high incidence of failure of primary healing. However, this does not justify failure to attempt repair of the cervical defects. Complete healing of the cervix occurred in 52 patients (Table XI), partial healing with minor residual defects in thirteen, and practically no healing in five. In one of the latter group the cervix was again repaired following her next delivery and healed. The status of cervical healing was not known in fourteen.

TABLE XI. HEALING OF CERVIX

	NO.	PERCENTAGE
Complete	52	61.9
Partial	13	15.5
No healing	5	6
Unknown	14	16.6

Two different techniques were used in suturing the cervix without significant difference in healing. After the adjacent endocervical tissue is



stripped away, the incisions were repaired with either interrupted or continuous lock sutures. Emphasis is placed on the use of fine suture material and careful approximation of tissue without rendering it more ischemic and therefore less likely to heal. In about one-third, the cervix was described as being markedly edematous. From the gross appearance of such tissue, it is somewhat surprising that healing takes place as well as it does.

### Maternal Results

More than 500 c.c. of blood was lost by 15, or 17.9 per cent (Table XII). In 13 of these patients hemorrhage was ascribed to an atonic uterus following prolonged labor. One hemorrhage was incidental to placenta previa. In only one patient was there brisk bleeding from the site of the cervical incisions. Actually the amount of bleeding from the cervix incised after a prolonged labor is less than that associated with a cervical laceration of comparable depth during a labor of normal duration. This difference in the first instance is probably due to the long period of relative ischemia of the cervix.

TABLE XII. POSTPARTUM COMPLICATIONS

	NO.	PERCENTAGE
Hemorrhage	15	17.9
Morbidity	17	20.2
Mortality	0	0

Seventeen, or 20.2 per cent, of the mothers had a temperature of 100.4° F. or more on two successive days post partum. This is about three times the usual incidence of morbidity based on this criterion. There were no maternal deaths.

One would anticipate that the babies would for the most part bear the brunt of these complicated labors. Seventy, or 81.4 per cent, of the infants appeared entirely normal (Table XIII). Twelve, or 13.95 per cent, were described as having some degree of asphyxia but in four of these cases general anesthesia had been used. Of the total series, 53 mothers were delivered with regional block anesthesia and 31 with general. None of the asphyxia group appeared abnormal during the neonatal period except for a transient facial paresis in two. Knowledge of the present status of these infants would be an important contribution to the evaluation of the effects of the complications encountered and the methods of delivery. But an adequate long-term follow-up was not accomplished.

TABLE XIII. FETAL SALVAGE

WEIGHT (GRAMS)	NO.	NORMAL	ASPHYXIA	STILLBORN	NEONATAL DEATHS
1,000-2,500	5	4	0	1	0
2,500-3,500	47	37	7	3	0
3,500-4,500	34	29	5	0	0
Total	86	70	12	4	0
Percentage	100	81.4	13.95	4.65	0

### Fetal Results

There were four stillborn infants and no neonatal deaths. The fetal and neonatal mortality rate in the cervical incisions series (4.65 per cent) compares favorably with that for total deliveries (3.43 per cent) including all infants whose birth weight was at least 1,000 grams (Table XIV). These data are of particular significance since all in the incisions series were associated with major maternal and/or fetal complications.

TABLE XIV. FETAL AND NEONATAL MORTALITY

	NO. OF INFANTS	DEATHS	PERCENTAGE
Incisions series	86	4	4.65
University Hospital (1935-1952)	12,773	438	3.43

Three of the four fetal deaths occurred prior to the advent of antibiotics (Table XV). In all three instances the mothers had signs of intrapartum infection and one had severe pre-eclampsia. The fourth fetal death was incidental to the placenta previa described previously.

TABLE XV. FETAL DEATHS

NO.	YEAR	WEIGHT (GRAMS)	LENGTH OF LABOR (HOURS)	TIME OF DEATH	TYPE OF DELIVERY	CAUSE OF DEATH
1	1935	2,910	49	Intra partum	Midforceps	Infection, as- phyxia
2	1938	2,724	47	Intra partum	Midforceps	Pre-eclampsia, as- phyxia
3	1942	3,234	35	Intra partum	Breech extraction	Infection, as- phyxia
4	1946	1,929	0	Ante partum	Breech extraction	Hemorrhage, pla- centa previa

One might reasonably expect that a major complication of pregnancy, particularly in the primigravida (88 per cent) would be a deterrent to future planned pregnancies. Because of the transient nature of the population in this community, the subsequent obstetrical histories are known in only 50 patients in the incisions series and most of these are among the more recent cases. Among these 50 patients there have been only 33 subsequent deliveries, all of which have been normal. Twenty-four patients have not had another pregnancy.

### Summary

A series of 84 patients is reviewed in whom cervical incisions were done because major maternal and/or fetal complications demanded termination of labor. Incisions of the cervix should play a definite but limited role in the practice of obstetrics. The incidence in this series was 0.66 per cent of the total deliveries during a seventeen-year period. If not technically so, cervical incisions to facilitate delivery must nonetheless be considered a major operation from the standpoint of the mother and fetus. Prolonged labor and oc-

cipitoposterior positions contributed to the majority of complications indicating cervical incisions. Severe cephalopelvic disproportion should serve as a contraindication to this procedure.

Optimum conditions that should prevail before cervical incisions are done and the techniques used are described.

Maternal morbidity occurred in 20.2 per cent and postpartum hemorrhage in 17.9 per cent. There were no maternal deaths.

Careful selection of cases should yield a high fetal salvage (95.35 per cent in this series). It is believed that in this series many infants were saved by this procedure and the fetal benefits outweighed the hazards attendant to incising the cervix and operative delivery from below.

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## THE PROGESTERONE CONTENT OF HUMAN PLACENTAS BEFORE AND AFTER THE ONSET OF LABOR

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THERE is an abundance of clinical and laboratory evidence indicating that progesterone is essential for the conservation of pregnancy in gravid mammals. The surgical elimination of the endogenous source of progesterone in the gravid animal results in the early termination of pregnancy,<sup>1, 2</sup> but if adequate progesterone substitution is provided, the pregnancy can be maintained satisfactorily.<sup>3</sup> It has also been demonstrated that parturition in the gravid rabbit at term can be indefinitely delayed by the administration of progesterone<sup>4</sup> or by the prolongation of ovarian luteal function.<sup>5, 6</sup>

These facts suggest that progesterone may have an effect on the initiation of labor in the gravid organism. The several theories currently popular are consistent with the concept that a failing source of progesterone secretion is requisite to the institution of labor.

Laboratory support of this concept has been lent by the analysis of the urine of pregnant women for pregnanediol. This substance, which has been shown to be a metabolite of progesterone,<sup>7, 8</sup> is excreted in the urine during pregnancy in increasing amounts to about the time of parturition. Prior to the onset of labor there is a decreasing excretion of pregnanediol<sup>9</sup> and after parturition the urinary pregnanediol concentration rapidly returns to non-gravid levels.<sup>10</sup>

Analysis of the blood of pregnant women for luteoid activity has been attempted with the resultant demonstration of blood progestin.<sup>11, 12</sup> However, a wholly satisfactory technique for the quantitative analysis of progesterone in the circulating blood has not been applied to the consideration of blood progesterone levels in the antepartum and postpartum states.

The source of progesterone in the gravid woman after the first trimester of pregnancy is considered to be the placenta. This view is supported by the clinical observation that castration of the pregnant woman after the first trimester does not inevitably result in abortion<sup>13</sup> and the urinary excretion of pregnanediol continues in undiminished amounts.<sup>10</sup> Further proof of the placental origin of progesterone is noted in the woman with a full-term abdominal pregnancy. The usual treatment of this unusual complication of pregnancy is the surgical removal of the fetus but the placenta is left in situ. When this unique situation occurs, the urinary excretion of pregnanediol continues after the delivery of the fetus. Placental death, as manifested by the absence of secretion of chorionic gonadotrophin, is rapidly followed by a decreasing excretion of pregnanediol to nongravid levels.<sup>14</sup>



In addition to the previous evidence regarding the placental origin of progesterone, direct bioassay of placental tissue has indicated luteoid activity.<sup>15, 16</sup> There has been a recent revival of interest in the secretion of progesterone by the placenta as indicated by the number of reports occurring in current medical literature.<sup>17-21</sup> Hormone yields have been reported as varying from zero to 1 mg. of progesterone per kilogram of placental tissue. Placental blood has been estimated to contain 0.4  $\mu$ g of progesterone per cubic centimeter.<sup>20</sup>

The general procedure followed by these investigators has been the preparation of a placental mash and subsequent digestion of the mash in sodium hydroxide. Extraction of the mash with a suitable lipid solvent was followed by chromatography or countercurrent distribution. The resultant product was quantitatively analyzed with the use of the ultraviolet spectrophotometer. Absorption of ultraviolet light at 240  $m\mu$  was used as the identifying characteristic. It should be mentioned that Salhanick and co-workers<sup>17</sup> recovered crystalline progesterone.

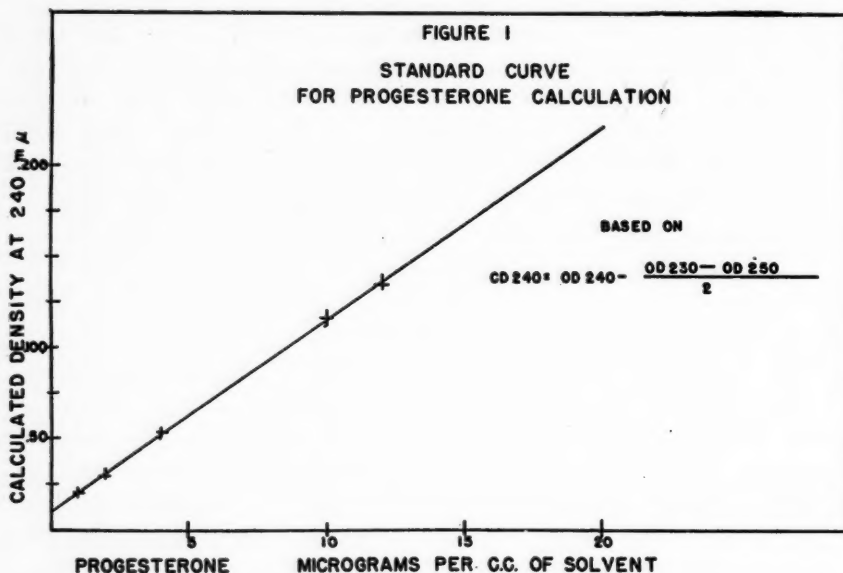
With the renewal of interest in placental progesterone and the definition of procedures for the recovery of the hormone, particularly the innovation of digesting the mash in sodium hydroxide, this reported experiment was planned. The project was designed to determine whether a measurable difference in the progesterone content of the human placenta existed before and after labor. This was to be effected by collecting placentas from women who were delivered by cesarean section without benefit of labor and another group of placentas from women in whom delivery was accomplished after a period of labor had ensued. Each placenta was processed separately. The result of the placental progesterone determinations in ten placentas prior to labor and ten placentas after labor are presented.

### Method

Placentas were collected from the delivery floor immediately after delivery. Those placentas not processed at once were stored in a freezer for future use. As previously noted two categories of placentas were obtained. One group, from patients who definitely were not in labor but in whom delivery was effected by cesarean section. This collection contained a number of abnormal placentas from patients with such diagnoses as diabetes, chronic glomerulonephritis, and eclampsia. The findings in these abnormal placentas are not included in this report. The remainder of the group consisted of patients in whom cesarean section was done because of cephalopelvic disproportion. These were designated as normal postpartum placentas before labor. The second group of placentas was obtained from patients who were delivered after a suitable period of labor. These placentas were identified as normal postpartum placentas after labor.

The placentas in each group were assayed individually. Each placenta was drained of blood. The membranes and cords were removed as well as surface blood and blood clots. The placenta was then weighed. After the placentas were homogenized in a high speed mixer an equal volume of 5 per cent NaOH was added to the mash. This was allowed to digest for 48 hours at which time an equal volume of diethyl ether was added and the mixture was left for another 24 hours. The ether was decanted from the container and the digest was extracted three more times with equal volumes of ether. The

ether extract was reduced in volume to 500 c.c. on the steam bath and was washed three times with 50 c.c. portions of distilled water. The ether extract was then reduced to dryness on the steam bath and the residue was dissolved in 10 c.c. of absolute ethanol. This was subjected to a modification of the Girard procedure for the separation of ketones from nonketones.<sup>22, 23</sup> The ketonic fraction thus obtained was finally dissolved in 95 per cent ethanol. The dilution was adjusted for ultraviolet studies. Following the ultraviolet absorption studies a suitable aliquot was prepared for paper chromatography.



Paper strips, 5 by 30 cm., were cut from Whatman No. 1 filter paper. The solution for analysis was placed on the starting line and the strips were placed in the chromatography jar for about 12 hours. A monophasic solvent system consisting of 80 per cent ethanol was used in the separation.<sup>24</sup> After allowing the strips to dry they were taken to a dark room and examined with an ultraviolet light source equipped with a Woods filter. The progesterone area on the strip was located as an ultraviolet absorbing area. This progesterone-bearing area was cut from the strip and placed in 95 per cent ethanol. The alcoholic solution of progesterone was then subjected to ultraviolet spectroscopy with the use of the Beckman spectrophotometer.

The ultraviolet absorption curves were analyzed quantitatively by a previously described method.<sup>25</sup> The formula,

$$CD\ 240\ m\mu = OD\ 240\ m\mu - \frac{OD\ 230\ m\mu + OD\ 250\ m\mu}{2}$$

was used in the calculation of the amount of progesterone present in the chromatographed sample. CD represents calculated density and OD represents observed density. The calculated density thus obtained was referred to a previously prepared standard curve, which is shown in Fig. 1. The accuracy of this method of calculation is dependent on a constant, straight line background absorption between 230 and 250 mμ. This is shown to be present in those ultraviolet absorption patterns obtained in samples in which no progesterone was identified, Fig. 2.

The previously described method establishes the presence of a steroid with a formula including an alpha-beta disubstituted ketone. It was neces-

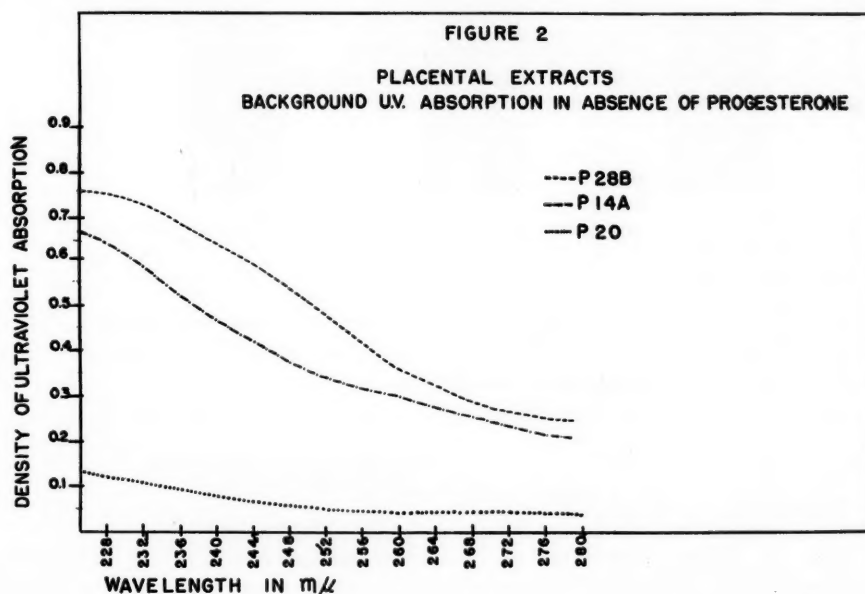
sary, therefore, to identify the compound further as progesterone, to establish luteoid activity. This was accomplished by the rabbit intrauterine assay procedure,<sup>26</sup> with resultant progestational proliferation of the endometrium being demonstrated.

In addition to the placental analyses, 290 c.c. of whole blood was obtained from five gravid women in the last trimester of pregnancy. This was processed in the same manner for progesterone analysis as the placentas were.

Two recovery experiments were planned. The first was to test the accuracy of the formula

$$CD\ 240\ m\mu = OD\ 240\ m\mu - \frac{OD\ 230\ m\mu + OD\ 250\ m\mu}{2}$$

In this a measured amount of progesterone was added to a previously analyzed solution in which no progesterone had been found. The solution was then reanalyzed on the spectrophotometer and the formula applied.

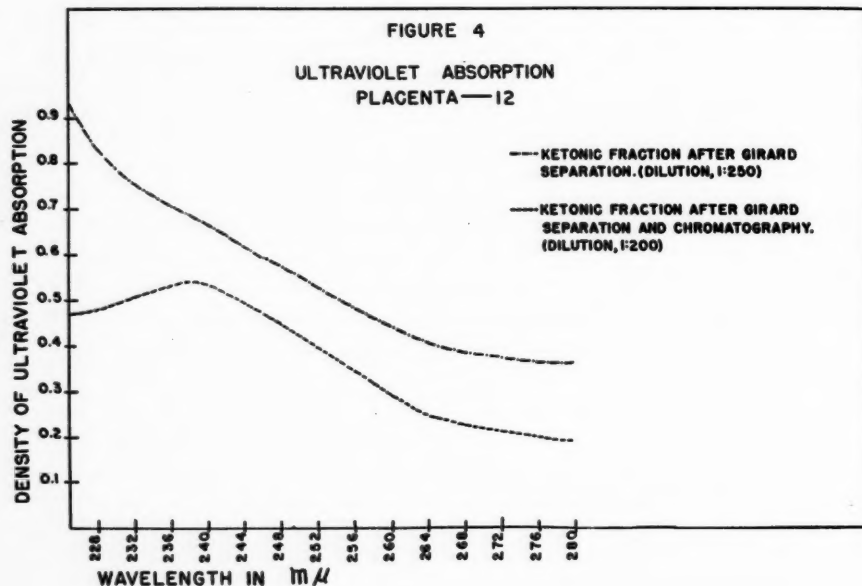
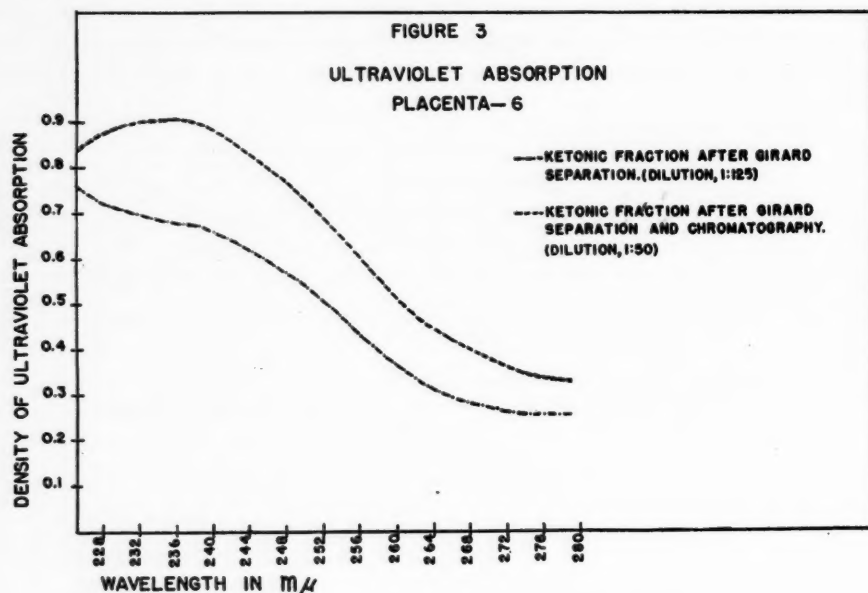


The second recovery experiment was used to demonstrate the recovery of progesterone for the entire procedure. This was accomplished by dividing a given placenta into two parts. To one part was added 1 mg. of crystalline progesterone before the addition of the NaOH. Then each portion was processed separately. The progesterone content of the untreated placental portion was determined and this figure used to calculate the original progesterone present in the "progesterone-added" placental portion. This calculated original progesterone was subtracted from the total amount obtained in the "progesterone-added" fraction. The resultant figure represented the recovery of the added progesterone.

### Results

Figs. 3 and 4 illustrate the usual ultraviolet absorption of the placental abstracts before and after chromatography. Although there is definite peak absorption at 240 mμ, it is obvious that the curves, even after chromatography, do not represent a chemically pure product. This is the reason that the formula for calculating the amount of progesterone present was needed.

Fig. 5 is included to depict the method of locating the progesterone area on the paper strip with the ultraviolet light source. These photographs were taken with ultraviolet light as the source of illumination. As labeled these strips contain, 50, 100, and 150  $\mu$ g. of progesterone, respectively.



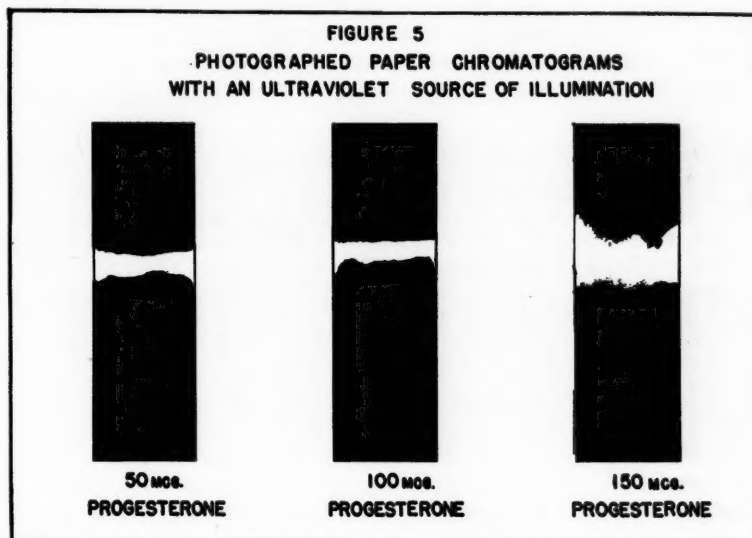
The recovery experiments to test the accuracy of the formula

$$CD\ 240\ m\mu = OD\ 240\ m\mu - \frac{OD\ 230\ m\mu + OD\ 250\ m\mu}{2}$$

are tabulated in Table I. The recovery of the added progesterone varied from 95 to 100 per cent. This was considered to be satisfactory evidence of the efficiency of the formula.



Table II lists the data obtained in the recovery of 1 mg. of progesterone added to the placental mash and followed with the procedure as previously described. The recovery in five instances varied between 67.9 and 88.5 per cent. The mean recovery was 76.3 per cent. The major loss of progesterone was considered, although not proved, to be during the Girard separation.



The progesterone content of the normal postpartum placentas after labor is shown in Table III. The amount present in each placenta varied from zero to 833  $\mu\text{g}$  of progesterone. The average amount found was 228  $\mu\text{g}$  of progesterone per placenta. The progesterone concentration varied from zero to 2.08  $\mu\text{g}$  of progesterone per gram of placenta with an average value of 0.69  $\mu\text{g}$  of progesterone per gram of placenta.

The placental progesterone content of the normal postpartum placentas before labor is shown in Table IV. The amount present in each placenta varied from 8 to 1,487  $\mu\text{g}$  of progesterone. The average amount found was 704  $\mu\text{g}$  of progesterone per placenta. The progesterone concentration was 0.02 to 2.80  $\mu\text{g}$  of progesterone per gram of placenta with an average value of 1.63  $\mu\text{g}$  per gram of placenta.

The pregnancy blood did not yield a demonstrable amount of progesterone.

#### Comment

In the consideration of the cause of labor in the gravid woman, one of the more appealing conjectures is that the deprivation of progesterone initiates the process of parturition. In the laboratory animal, particularly the rabbit, this concept is more than conjecture.

The following observations in the rabbit and the monkey are cited as proof of the need for progesterone in the maintenance of pregnancy and conversely that the deprivation of progesterone results inevitably in parturition.

1. Castration of the gravid rabbit, in which the source of progesterone is ovarian, results in the onset of labor.

TABLE I. RECOVERY OF ADDED PROGESTERONE USING FORMULA

$$\text{CD } 240 \text{ m}\mu = \text{OD } 240 \text{ m}\mu - \frac{\text{OD } 230 \text{ m}\mu + \text{OD } 250 \text{ m}\mu}{2}$$

NUMBER	PROGESTERONE ADDED	PROGESTERONE RECOVERED	RECOVERY PER CENT
1	170 $\mu\text{g}$	164 $\mu\text{g}$	96.4
2	150 $\mu\text{g}$	150 $\mu\text{g}$	100.0
3	200 $\mu\text{g}$	195 $\mu\text{g}$	97.5
4	200 $\mu\text{g}$	190 $\mu\text{g}$	95.0
5	200 $\mu\text{g}$	200 $\mu\text{g}$	100.0

TABLE II. RECOVERY OF ADDED CRYSTALLINE PROGESTERONE FROM THE PLACENTAL MASH

NUMBER	LABOR	WEIGHT PLACENTAL ALIQUOT	PROGESTERONE ADDED	PROGESTERONE RECOVERED	RECOVERY ORIGINAL PROGESTERONE	RECOVERY ADDED PROGESTERONE
25-A	Yes	140 grams	0000	7.5 $\mu\text{g}$	7.5 $\mu\text{g}$	---
25-B	Yes	170 grams	1,000 $\mu\text{g}$	720.0 $\mu\text{g}$	9.1 $\mu\text{g}$	711.9 $\mu\text{g}$
24-A	Yes	150 grams	0000	312.5 $\mu\text{g}$	312.5 $\mu\text{g}$	---
24-B	Yes	250 grams	1,000 $\mu\text{g}$	1,200.0 $\mu\text{g}$	520.8 $\mu\text{g}$	679.2 $\mu\text{g}$
14-A	Yes	260 grams	0000	000	000	---
14-B	Yes	190 grams	1,000 $\mu\text{g}$	750.0 $\mu\text{g}$	000	750.0 $\mu\text{g}$
18-A	No	220 grams	0000	315.0 $\mu\text{g}$	315.0 $\mu\text{g}$	---
18-B	No	220 grams	1,000 $\mu\text{g}$	1,200.0 $\mu\text{g}$	315.0 $\mu\text{g}$	885.0 $\mu\text{g}$
28-A	Yes	190 grams	0000	000	000	---
28-B	Yes	210 grams	1,000 $\mu\text{g}$	790	000	790.0 $\mu\text{g}$

TABLE III. POSTPARTUM PLACENTAS AFTER LABOR

NUMBER	GESTA- TION (WEEKS)	DELIVERY	ANESTHESIA	LABOR (HOURS)	FETAL WEIGHT	PLACENTAL WEIGHT	PRO- GESTERONE TOTAL	PROGESTERONE CONCENTRA- TION
13	42	Vaginal	Pudendal	14	2,560 grams	320 grams	330 $\mu\text{g}$	1.03 $\mu\text{g./gram}$
14	40	Vaginal	Inhalation	5	3,120 grams	450 grams	000 $\mu\text{g}$	0.00 $\mu\text{g./gram}$
20	41	Section	Caudal	5	3,120 grams	250 grams	000 $\mu\text{g}$	0.00 $\mu\text{g./gram}$
21	37	Section	Inhalation	6	2,800 grams	460 grams	050 $\mu\text{g}$	0.08 $\mu\text{g./gram}$
23	38	Vaginal	Pudendal	7	2,590 grams	240 grams	475 $\mu\text{g}$	1.98 $\mu\text{g./gram}$
24	37	Vaginal	Inhalation	4	3,580 grams	400 grams	833 $\mu\text{g}$	2.08 $\mu\text{g./gram}$
25	40	Vaginal	Inhalation	18	2,760 grams	310 grams	20 $\mu\text{g}$	0.06 $\mu\text{g./gram}$
26	39	Vaginal	Caudal	10	3,460 grams	338 grams	470 $\mu\text{g}$	1.39 $\mu\text{g./gram}$
27	41	Vaginal	Inhalation	8	3,510 grams	340 grams	108 $\mu\text{g}$	0.32 $\mu\text{g./gram}$
28	40	Section	Caudal	8	3,620 grams	400 grams	000 $\mu\text{g}$	0.00 $\mu\text{g./gram}$
Average							228 $\mu\text{g}$	0.69 $\mu\text{g./gram}$

TABLE IV. POSTPARTUM PLACENTAS BEFORE LABOR

NUMBER	GESTA- TION (WEEKS)	DELIVERY	ANESTHESIA	LABOR (HOURS)	FETAL WEIGHT	PLACENTAL WEIGHT	PRO- GESTERONE TOTAL	PROGESTERONE CONCENTRA- TION
7	40	Section	Inhalation	0	3,410 grams	530 grams	1,487 $\mu\text{g}$	2.80 $\mu\text{g./gram}$
8	40	Section	Caudal	0	2,579 grams	390 grams	575 $\mu\text{g}$	1.47 $\mu\text{g./gram}$
9	41	Section	Caudal	0	2,710 grams	300 grams	625 $\mu\text{g}$	2.09 $\mu\text{g./gram}$
10	39	Section	Inhalation	0	3,200 grams	390 grams	637 $\mu\text{g}$	1.63 $\mu\text{g./gram}$
11	38	Section	Caudal	0	3,288 grams	410 grams	425 $\mu\text{g}$	1.03 $\mu\text{g./gram}$
12	39	Section	Caudal	0	3,560 grams	490 grams	1,050 $\mu\text{g}$	2.12 $\mu\text{g./gram}$
19	40	Section	Inhalation	0	3,780 grams	460 grams	8 $\mu\text{g}$	0.02 $\mu\text{g./gram}$
31	38	Section	Inhalation	0	3,490 grams	410 grams	750 $\mu\text{g}$	1.83 $\mu\text{g./gram}$
32	34	Section	Caudal	0	2,470 grams	450 grams	790 $\mu\text{g}$	1.75 $\mu\text{g./gram}$
33	38	Section	Local	0	3,830 grams	436 grams	690 $\mu\text{g}$	1.58 $\mu\text{g./gram}$
Average							704 $\mu\text{g}$	1.63 $\mu\text{g./gram}$

2. In the oophorectomized gravid rabbit, the pregnancy can be maintained with adequate progesterone substitution therapy.

3. The experimental prolongation of luteal function in the ovaries of the intact gravid rabbit at term results in the postponement of parturition.

4. The administration of progesterone to the intact gravid rabbit at term results in the postponement of parturition.

5. Distention of the uterus is said to be a cause of labor. Those rabbits treated with progesterone at term have oversized fetuses with more than average uterine distention but nevertheless do not go into labor until progesterone is withdrawn.

6. Removal of the fetus from the gravid monkey uterus, leaving the placenta in situ, results in the delivery of the placenta at term, despite the obvious lack of uterine distention.<sup>27</sup>

The evidence that progesterone is essential to the conservation of pregnancy in the human being and that the deprivation of progesterone results in labor is less direct than the previously mentioned animal observations but is available.

1. The primary source of progesterone in the first trimester of pregnancy is ovarian. After the first trimester the placenta assumes the major role in the production of progesterone.

2. Pregnanediol is a major excretion product of progesterone and reflects the rate of progesterone secretion in the organism.

3. Progesterone is metabolized rapidly in the rabbit<sup>28</sup> and in the human being. About 90 per cent of intravenously administered progesterone disappears from the blood stream within 5 minutes after the injection.<sup>29</sup> Relatively large amounts of progesterone can be demonstrated in placental blood but none can be shown in the peripheral blood. If the source of progesterone failed, in the human being, the progesterone available to the organism in the peripheral blood would be rapidly dissipated.

4. When the ovary is the major source of progesterone, bilateral oophorectomy results in the expulsion of the products of conception from the uterus.

5. When the placenta has assumed its progesterone-secreting activities, castration does not inevitably result in abortion, nor is castration at this time followed by a decrease in the urinary excretion of pregnanediol.

6. A totally satisfactory method of determining circulating progesterone in the peripheral blood has not been applied to progesterone blood concentrations before and after labor.

7. This current report indicates placental progesterone concentration before labor at twice that of placental progesterone concentration after labor. Since progesterone disappears rapidly from the blood stream it follows that these patients would have had a considerable reduction in circulating progesterone at labor.

In conclusion, the observation that there is a demonstrable difference in placental progesterone before and after labor is offered as further evidence that progesterone deprivation is a cause of labor.

### Summary

A method for the quantitative analysis of individual human placentas for progesterone has been presented. There was a satisfactory recovery of progesterone added to placentas. The progesterone content of normal postpartum placentas prior to the onset of labor is about twice that of normal postpartum placentas after the onset of labor.

The evidence for progesterone deprivation as a cause of labor was reviewed. The findings of the study of the progesterone content of human placentas provides additional evidence that progesterone deprivation is a cause of labor.

I wish to express my gratitude to Dr. Willard M. Allen for his suggestions in the preparation of this report.

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## THE USE OF LARGE DOSES OF PROGESTERONE\* IN DELAYING THE ONSET OF LABOR AFTER PREMATURE SPONTANEOUS RUPTURE OF THE MEMBRANES: II

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SIXTY patients with premature spontaneous rupture of the membranes between the twentieth and thirtieth weeks of gestation have been brought to our attention. Eighteen patients are controls, and the remainder were started on treatment with large doses of progesterone. Fifteen of these have been reported previously,<sup>2</sup> at which time the literature on the relationship of prematurity to the latent period preceding the onset of labor was reviewed. At that time Ballard<sup>1</sup> was the only reference with specific statements on the subject. She stated there was no relationship between babies' weights and the latent period. To date we have been unable to find any other reference challenging that statement. Other authors have agreed that 90 per cent of patients near term are in labor within twenty-four hours of rupture of the membranes, and seldom is the latent period over 120 hours.

The control cases are divided into two groups, the first of which consists of 8 patients who came to the hospital and delivered before definitive treatment had begun. Fetal salvage was zero. By history, the average elapsed time between the premature rupture of the membranes and the onset of labor was just under 100 hours. The latent period reached seven days in one patient. We realize that this is not completely accurate because some of the histories were indefinite and vague in their time relationship.

The second section of the control group includes all patients admitted shortly after the rupture of membranes occurred who were treated by bed rest, sedation, antibiotics, and various types of hormone therapy. Although several members of this group received progesterone up to 50 mg. twice daily, none received the high dosage described hereafter. Almost all received stilbesterol, some by the "Smith routine" and some by the "Karnaky routine." Two delivered within the first twenty-four hours; one was delivered on the eleventh day; and one had a latent period of seventeen days. The average latent period was just under seven days. Several infants were born alive, one of whom lived for two weeks. However, no infant left the institution alive. Eventual fetal salvage was again zero, as immaturity took its toll. The infant of the seventeen-day latent period was delivered in the twenty-fourth week of

\*Proluton, 100 to 200 mg. per milliliter, was furnished by Schering Corporation through the auspices of Dr. Norman Heminway, Associate Director of Research.

pregnancy, and survived only two days. No apparent adverse effect on the mother was noted, and several mothers have since delivered term infants without difficulty.

The 27 actively treated patients not previously reported constitute the balance of this survey. These were admitted and initially treated as were the second control group. "Routine perineal preparation" was given each patient on admission, and she was kept in bed and received daily antibiotics. Most were given penicillin by injection. Six received vaginal therapy, 2 each on Terramycin tablets, Terramycin suppositories, and penicillin-streptomycin suppositories. Results were satisfactory in each case, temporary complete vaginal sterility occurring with Terramycin. Only one patient in the entire group (St. Ann No. J-70) developed fever while under treatment (penicillin daily). She had chills on the fifth day, went into active labor, and delivered the same day in the thirtieth week. The infant died on the fourth neonatal day of hemolytic anemia, probably septic in origin. Maternal convalescence on Terramycin was satisfactory. It seems that if satisfactory care and cleanliness are used, infection is not a frequent or dangerous complication of prolonging the latent period after premature rupture of the membranes. All patients in this series had an initial sterile vaginal examination to verify the diagnosis, and, thereafter, except for those who received vaginal antibiotics, had no manipulation.

Progesterone medication has been modified somewhat from our first report. Patients now receive 200 mg. in deep intramuscular injections for a total of 400 to 600 mg. daily for the first two to three days. Dosage is reduced to 100 mg. twice daily for the next three to five days, and then to 100 mg. daily if the patient remains in the hospital. Most leave by the seventh day. After discharge, an attempt was made to continue therapy at 100 mg. two to three times weekly through the thirty-third or thirty-fourth week. This was not always practicable. We no longer permit our patients to get out of bed and become active on their discharge from the hospital. Only bathroom privileges "with great care" are permitted, since we lost 5 consecutive infants by prolapsed cords on the first to eighth day at home. This accident first occurred to our fifteenth patient. We attempt to maintain bed rest to the thirty-fifth week.

About half of the women admitted in what might be considered active labor will stop contractions despite the presence of effacement and slight cervical dilatation. However, those who had taken paregoric at home, or received Demerol in the hospital proceeded to empty the uterus with despatch a few hours after the first or second progesterone injection. Other opiates have the same effect. We now, therefore, interdict the use of any natural or synthetic opium derivative on any patient receiving progesterone, if she is to remain under our supervision.

Only one serious accident has occurred. This patient (Mt. Sinai No. 6798) was admitted in desultory labor eleven days after premature rupture of the membranes, and eight days after having signed her release from the hospital. She had received 900 mg. of progesterone during three days of therapy. She suffered a spontaneous rupture of the uterus on the thirteenth day while in

the hospital and delivered a stillborn infant by section hysterectomy. Steroid analyses of the uterine wall, the rupture and the placental sites were done.<sup>3</sup> No significant information was obtained.

Total fetal salvage in these 27 patients is 9 infants. However, labor was induced in 6 others because of fetal death following belated prolapse of the cord. Four patients delivered within the first twenty-four hours, but after therapy had been started. Two delivered on the second day. Three delivered on the fifth day. All others went home undelivered on their first admission to return at a later date. Six patients delivered stillborn infants or infants who died in the early neonatal period after prolapse of the cord on the eighth to sixteenth day after rupture of the membranes. Two delivered stillborn infants associated with premature separation of the placenta on the seventh and eighteenth days of ruptured membranes, respectively. One was lost through rupture of the uterus. The remaining 9 infants were born alive at twenty-nine weeks to term, and all left the hospital gaining weight. One of the infants born at twenty-nine weeks had a visual difficulty which was not retrolental fibroplasia. This was a surviving twin. The other died a few hours after delivery.

### Summary

An unselected group of 42 patients with premature spontaneous rupture of the membranes between the twentieth and thirtieth weeks of gestation were treated by bed rest, antibiotics, and high progesterone therapy. Controls were few and included patients either untreated or treated by other methods. Both groups are too small for statistical analyses, but results of therapy have been consistently better in the treated group.

### Conclusions

The latent period normally seems to have an inverse relation to the period of gestation, being longest in those patients farthest from term. Increasing this latent period between premature rupture of the membranes and labor is apparently not an unsafe procedure. The use of opium derivatives during the period of administration of large doses of progesterone seems to hasten delivery. The results obtained warrant further study and the continuation of the present dosage schedule. However, since we see only slightly more than one patient each month who answers the strict criteria for treatment, we request the cooperation of other groups that this method may be truly evaluated.

We wish to express our appreciation to the visiting staffs of Mt. Sinai and St. Ann Hospitals as well as to the other obstetricians who permitted us to direct treatment of their private patients.

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## THE PROBLEM OF THE LARGE FETUS\*

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THE problem of the large fetus has always been difficult to define. A great wealth of literature has been produced on cephalopelvic disproportion, but very little has appeared on the relationship between excessive fetal size and obstetrical complications.

This paper is an analysis of a group of pregnancies resulting in large infants, in an effort to uncover any pertinent factor related to this problem. Nine pounds (4,082 grams) was chosen arbitrarily as the lower limit of excessive fetal size.

### *Incidence.—*

During the period, April, 1949, through November, 1952, there were 8,777 deliveries at the United States Naval Hospital, Oakland, Calif., of which 462 (5.3 per cent) of the infants weighed 4,082 grams or more. As several of these records are unavailable, the following statistics are drawn from 441 deliveries of 415 different women.

### *Age and Race of the Mothers.—*

Table I gives the age and race of the mothers.

TABLE I. AGE AND RACE

AGE (YEARS)	PERCENTAGE	RACE	PERCENTAGE
Less than 20	20	White	98
20-35	77	Negro	1
35 and older	3	Malayan, Mongolian, and Polynesian	1

Although precise statistics are not available, the number of Negro patients is approximately 10 per cent of the entire obstetrical clinic. This is in accord with the known fact that Negroes tend to have smaller infants than Caucasians.

### *Parity and History of Previous Large Infants.—*

The parity of the mothers is indicated in Table II.

TABLE II. PARITY

DELIVERIES	NUMBER	PERCENTAGE
Primiparous	132	30
Multiparous	309	70

The general incidence of primiparity on the obstetrical service during this period was 46 per cent.

\*The opinions expressed herein are those of the author and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.



The 292 multiparas in this series had had 507 previous deliveries, of which 125 infants (24.7 per cent) were of excessive size—almost five times the general incidence of 5.3 per cent. These 125 large infants were distributed among 99 of the 292 multiparas.

*Diabetes Mellitus.*—

There were no diabetic patients in this group, and only 5 women were recorded as having diabetic parents. This is actually not a valid statistic, as the policy is to admit diabetics approximately three weeks before term for section or induction. Nathanson<sup>1</sup> found 2.77 per cent diabetic mothers in a series of large infants, as opposed to a general incidence of 0.3 per cent. Kriss and Futche<sup>2</sup> reported that 17 per cent of the mothers of infants that weigh more than 10 pounds and 51 per cent of mothers of infants that weigh more than 12 pounds eventually develop diabetes in later life, as opposed to an over-all incidence of 4.3 per cent.

*Prenatal Weight Gain.*—

Although it is our policy to advise patients to restrict weight gain to less than 20 pounds, 25 pounds was chosen as the border line for excessive gain. The patients were classified into four groups (Table III). "Normal" weight before pregnancy is liberally interpreted so as to include the slightly chubby girl. Forty per cent gained over 25 pounds, and 29 per cent more than 30 pounds. Fifteen per cent were grossly overweight at the onset of pregnancy, and 50 per cent were within a totally normal category. It would appear that excessive weight gain is more common in this group with large infants than in those with infants of normal size, but not nearly enough to be of any prognostic value. Original weight has no discernible relation to fetal size.

TABLE III. PRENATAL WEIGHT GAIN

WEIGHT GAIN	NORMAL WEIGHT BEFORE PREGNANCY (%)	OVERWEIGHT BEFORE PREGNANCY (%)
25 pounds or less	50	10
More than 25 pounds	35	5

Other authors have found varying results. Klein<sup>3</sup> reported no correlation between maternal weight gain and fetal weight, while Kerr<sup>4</sup> and Beilly and Kurland<sup>5</sup> claimed a slight relationship, the latter also stating that heavier women tend to have heavier offspring regardless of weight gain. In reference to the use of strict dietary measures to take advantage of this dubious correlation, Smith<sup>6, 7</sup> has shown that during a period of acute wartime starvation in Holland, the average fetal weight was only 200 to 300 grams less than previously.

Although there is a slight correlation between maternal weight gain and fetal size, it is not a dominant factor in this series.

*Height of Mother.*—

There is no visible correlation between the height of the mother and excessive fetal size (Table IV).

TABLE IV. HEIGHT OF MOTHER

HEIGHT OF MOTHER	PERCENTAGE
5'10" and taller	1.7
5'8" to 5'10"	10.3
5'1" to 5'8"	80.5
5'0" to 5'1"	7.0
Less than 5'0"	0.5

*Duration of Pregnancy.—*

As the estimated date of confinement (EDC) in each case is based on subjective data (last menstrual period, LMP), there undoubtedly are many instances of gross inaccuracy (Table V). These figures are not striking, but certainly the percentage of those more than two weeks late is above the average. Speitkamp's<sup>8</sup> statistics revealed only 6 per cent with a duration of pregnancy amounting to more than 14 days beyond EDC, in a series of 14,078 infants that weighed more than 2,800 grams. Rathburn,<sup>9</sup> in analyzing a group of "post-mature" deliveries, found a significant increase in average birth weight (270 grams). Calkins,<sup>10</sup> however, in a larger series, found a much more significant correlation of fetal weight with placental size than with the number of days overdue. The fetal weight increment averaged 900 grams between cases with placentas less than 500 grams and those with placentas greater than 700 grams. In contrast, the fetal increment between pregnancies of 280 and 300 days' duration averaged 120 grams. He concluded that there was no problem of postmaturity.

TABLE V. DURATION OF PREGNANCY

DURATION BEYOND EDC	PERCENTAGE
Less than 15 days	77
15 through 21 days	12.5
22 through 28 days	8.0
29 days and longer	2.5
Longer than 15 days	23

In this present series, the percentage of supposedly prolonged pregnancies is above average, but postmaturity cannot be interpreted as a major factor in the causation of excessive fetal weight.

*Complications of Pregnancy.—*

Only the complications which were severe enough to require hospitalization are recorded. There were 5 per cent with pre-eclampsia and 1.4 per cent with anemia. No other entity was prominent enough to justify listing. The incidence of toxemia appears to be no different from that of the entire clinic. It is interesting to note that large infants may occur in patients with severe anemia.

*Duration of Labor (Table VI).—*

It is apparent that excessive fetal size does not affect the rate of cervical dilatation. Second-stage statistics are difficult to interpret as many cases, especially primiparous, were terminated by forceps. However, it is reasonable

to assume that the large fetus requires more time to overcome the resistance of the pelvic floor than the average one. As expected, this time increment is more marked in the primipara.

TABLE VI. DURATION OF LABOR

DURATION	PRIMIPARAS (%)	MULTIPARAS (%)
<i>First Stage.—</i>		
Less than 8 hours	43	73
Less than 16 hours	79	94
Less than 24 hours	96	97
24 to 48 hours	3	3
More than 48 hours	1 (1 case)	0
<i>Second Stage.—</i>		
Less than 1 hour	47	92
Less than 2 hours	77	97.5
2 to 3 hours	14	2.2
More than 3 hours	9	0.3 (1 case)

That a second stage greater than 2 hours occurred in only 2.5 per cent of the multiparas shows how negligible is the problem of prolonged labor in this group.

*Anesthesia.—*

The primiparas were delivered predominantly under conduction anesthesia. In the last year of the series, there were very few caudal and a marked increase in saddle block anesthetics (Table VII).

TABLE VII. ANESTHESIA USED

TYPE	NO. OF CASES
Nitrous oxide and/or pudendal, or local block	244
Saddle block	150
Caudal, single injection	45
Caudal, continuous	2

*Lacerations.—*

As would be expected, there was a higher than average incidence of lacerations, 12 per cent of the primiparas and 10 per cent of the multiparas having second-degree lacerations and 6 per cent of the primiparas and 1 per cent of the multiparas, third-degree. All the tears in primiparas were episiotomy extensions. A sizable number of the lacerations in the multiparas were avoidable and represent misguided attempts to escape an episiotomy repair.

*Hemorrhage, Third Stage.—*

Blood loss in the third stage amounted to 500 to 600 c.c. in 16 cases and over 600 c.c. in 4 cases. These figures are admittedly questionable, in view of the widespread tendency to underestimate blood loss. Nevertheless, they offer no support to the general impression that there is an increased incidence of hemorrhage in the delivery of large infants.

*Sex of Infant.—*

In the total group studied, 68.9 per cent of the infants were male and 31.1 per cent female. Of the infants that weighed over 4,500 grams, 70.2 per cent

were male. This predominance of male infants has been confirmed by remarkably similar statistics in other series.<sup>1, 11</sup> No adequate explanation can be offered for this phenomenon.

*Fetal Weight (Table VIII).—*

The largest infant in the entire series weighed 5,300 grams.

TABLE VIII. FETAL WEIGHT

WEIGHT (GRAMS)	NUMBER OF CASES	PERCENTAGE
4,082-4,499	394	89.3
4,500-4,999	41	9.3
5,000 and over	6	1.4

*Fetal Injuries.—*

There were only three nonfatal injuries, two fractured clavicles and one transient facial palsy. A higher incidence of trauma might be expected. Perhaps the extensive use of conduction anesthesia in primiparas influenced this favorably.

*Presentation and Method of Delivery.—*

Of all the deliveries, 98.2 per cent were vertex presentations while only 1.8 per cent were breech. The method of delivery is summarized in Table IX.

TABLE IX. METHOD OF DELIVERY

METHOD	NO. OF CASES	PERCENTAGE
Spontaneous (vertex)	279	62.9
Low forceps	144	33.0
Midforceps	7	1.6
Breech	8	1.8
Cesarean section	3	0.7

The percentage of spontaneous deliveries decreased in the last year of the series, as more elective low forceps deliveries were performed. The midforceps incidence is slightly higher than the general average of 0.7 per cent found in this clinic, but is still quite low. Surprisingly enough, 5 of the 7 midforceps deliveries were performed on multiparas and only one infant weighed over 4,500 grams.

The cesarean section rate is of interest only because it is very low. One of the three was a scheduled repeat cesarean section. The second case was an unsuccessful trial of labor in a woman with a contracted pelvis and a fetus of 4,280 grams. The third was an unsuccessful trial, with high arrest of a 4,200 gram fetus in a woman with an apparently adequate anthropoid pelvis. All three were vertex presentations.

*Mortality.—*

There were only two fetal (0.45%) and no maternal deaths in the entire series. During this same period the fetal mortality (neonatal plus stillbirths) of all deliveries at term was 0.78 per cent.



*Case Histories in the Two Fetal Deaths.—*

CASE 1.—A 27-year-old gravida i, who had an adequate pelvis (biischial, 10.5 cm.; diagonal conjugate not reached at 12 cm.; sacrum, normal curve; subpubic arch, wide; spines, not prominent), entered in poor labor and, after 16 hours of the first stage, presented a foot at the outlet. Four hours of fairly good labor were allowed from this point, without progress. The patient was then given a saddle block anesthesia, and a breech extraction was performed. Delivery was easy to the umbilicus, after which considerable trouble was encountered with nuchal arms. The cervix was tightly clamped on the fetal head, which was at a high midstation. Delivery was completed with Piper forceps, with resultant bilateral cervical lacerations. The infant was a flaccid female, weighing 4,082 grams, who responded after persistent resuscitation. She died suddenly 48 hours later. Autopsy revealed a subdural hematoma.

CASE 2.—A 27-year-old gravida i, with an adequate pelvis by x-ray pelvimetry (true conjugate, 12.6 cm.; transverse inlet, 13.4 cm.; midpelvis, anterior-posterior, 12.6 cm.; interspinous, 10.8 cm.; biischial, 10.2 cm.; postsagittal, 7.1 cm.), entered with a frank breech presentation and had a normal first stage of 14 hours. Progress in descent in the second stage was negligible, and after 2½ hours with the presenting part at plus 2, the fetal heart became irregular. A decomposition and extraction of the frank breech was performed under saddle block anesthesia. Considerable difficulty was encountered with the fetal head, and strong traction was necessary on the Piper forceps to complete the delivery. The placenta was expelled spontaneously a few seconds after the delivery, with approximately 300 c.c. of blood behind it. The fetus, that weighed 4,310 grams, was stillborn. Autopsy revealed subdural and subgaleal hematomas.

The fact that both deaths occurred in breech presentations is striking. A brief analysis of the eight breech deliveries, therefore, is presented in Table X.

TABLE X. ANALYSIS OF EIGHT BREECH DELIVERIES

PAR-ITY	PELVIS	PRESENTA-TION	HOURS OF LABOR	METHOD OF DELIVERY	COMPLICA-TIONS OF LABOR	ANES-THESIA	FETAL WEIGHT (GRAMS)	CONDITION OF INFANT
0	Adequate	Frank	18	Assisted	0	N <sub>2</sub> O, pudendal	4,140	Good
0	Adequate	Frank	26	Assisted*	0	Pudendal	4,365	Good
0	Adequate	Complete	39	Extraction*	0	Caudal	4,365	Good
0	Adequate	Single foot	20	Extraction*	(1)	Saddle	4,082	Neonatal death
0	Adequate	Frank	17	Extraction*	(2)	Saddle	4,480	Stillbirth
i	Adequate	Frank	6	Assisted	0	Pudendal	4,310	Good
ii	Adequate	Frank	8	Assisted*	0	Saddle	4,110	Good
i	Adequate	Frank	32	Assisted	Primary uterine inertia	Pudendal	4,110	Good

\*Piper forceps to aftercoming head.

(1) See Case 1.

(2) See Case 2.

The fetal deaths represent two-thirds of the extractions, and two-fifths of the primiparas. It is evident that breech extraction involves a high risk of severe trauma to the large infant. All primiparas with breech presentations should have careful evaluation of x-ray pelvimetry before vaginal delivery is attempted. Those with any evidence of cephalopelvic disproportion should undergo elective cesarean section. Patients permitted to go into labor with excessively large infants in breech presentation must be observed very closely. It would appear that cesarean section offers the best salvage rate in those who are not making progress in descent during labor.

### Summary and Conclusions

1. A series of 441 deliveries of infants that weighed 4,082 grams and over has been analyzed.

2. Thirty per cent of the mothers were primiparas. The general incidence of primiparity on the obstetrical service during this period was 46 per cent. Of the children previously born to the multiparas, 24.7 per cent were of excessive size, as compared to a general incidence of 5.3 per cent.

3. Although excessive maternal weight gain and postmaturity were more common than average, no striking etiological relationship could be established.

4. The first stage of labor was unaffected by fetal size. The second stage was longer than two hours in 23 per cent of the primiparas and in only 2.5 per cent of the multiparas.

5. There was an increased incidence of perineal lacerations. It is believed that many of these lacerations could have been avoided by more adequate mediolateral episiotomies.

6. No significant increase in third-stage hemorrhage was noted.

7. Of the infants, 68.9 per cent were male.

8. Fractured clavicles and other nonfatal injuries were surprisingly infrequent (3 in 441 cases).

9. There were 7 midforceps deliveries (1.6 per cent), and 3 cesarean sections (0.7 per cent). One of the latter was a repeat section.

10. Of the 441 cases, there were two fetal and no maternal deaths. There was no mortality in the vertex presentations. Both cases of fetal death were in difficult breech extractions in primiparas. These deaths represent two-fifths of the primiparous breech deliveries and two-thirds of the extractions. Breech extraction is highly traumatic to the large infant, and should not be undertaken without clear indications, especially in the primipara. X-ray pelvimetry should be done on all primiparas with breech presentations, and those with any evidence of cephalopelvic disproportion should undergo elective cesarean section. In patients permitted to go into labor with excessively large infants in breech presentation, cesarean section is indicated in those who are not making progress in descent during labor.

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## MASSIVE POSTPARTUM HEMORRHAGE ASSOCIATED WITH COAGULATION DEFECT

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FOR many years obstetricians have been reporting occasional hemorrhagic tendencies associated with toxemia of pregnancy. DeLee<sup>1</sup> in 1901 noted a "temporary hemophilia" following abruption of the placenta. Williams<sup>2</sup> in 1915 cited a fatal hemorrhage following abruptio placentae due to a failure in the clotting mechanism. Willson<sup>3</sup> in 1922, reporting 69 cases of abruptio placentae, had 14 fatalities due to continued hemorrhage. He thought that a toxin, "hemorrhagin," produced by the placenta, disturbed the clotting mechanism. Dieckmann,<sup>4</sup> in 1936, actually demonstrated lowered fibrinogen levels in patients who hemorrhaged following abruptio placentae. Kellogg,<sup>5</sup> in 1945, noted five fatal hemorrhages in 9 patients with premature separation of the placenta. Dillon and Schmitz,<sup>8</sup> in 1949, reported two cases of fibrinogenopenia associated with fulminating eclampsia.

Certain of the pathological lesions often found in eclamptic patients, involving the liver, kidney, and brain, focal infarction and necrosis, have been reduplicated experimentally in rabbits after the intravenous administration of thromboplastin by Schneider,<sup>12</sup> in dogs by Page, Fulton, and Glendening.<sup>13</sup> Schneider found multiple fibrin emboli in the lungs of the rabbits. He postulated that, either from abruptio placentae or from a retroplacental hematoma, the thromboplastin-rich decidua released tremendous amounts of thromboplastin into the maternal circulation via the maternal lakes in the placenta.<sup>9</sup> The thromboplastin sets off intravascular clotting, forming many minute fibrin emboli which are then disseminated throughout the body. Depletion of the circulating fibrinogen occurs, followed by hemorrhagic diathesis. Page and associates<sup>13</sup> agree with Schneider's hypothesis. These authors could not demonstrate a plasma fibrinolytic enzyme in their experimental dogs nor in five clinical cases of abruptio placentae. The Smiths,<sup>6</sup> in 1945, demonstrated the presence of a fibrinolytic enzyme in toxic patients. MacFarlane and Biggs,<sup>7</sup> in 1948, showed a lytic factor to be demonstrable in the presence of shock. Recently, Weiner, Reid, Roby, and Diamond<sup>11</sup> reported afibrinogenemia in occasional isoimmunized mothers who carried a dead fetus. Finally, a possible etiological factor to be considered may be the production of some toxic placental or fetal substance which depresses the formation of fibrinogen by the maternal liver.

Despite the uncertainty of the pathological physiology, we are fortunate in that recognition of this syndrome is not very difficult provided the physician is cognizant of its possibility and potentialities. Afibrinogenemia has been described in occasional patients who manifest the following obstetric complications:

(1) toxemia of pregnancy; (2) premature separation of the placenta; (3) isoimmunization, associated with a dead fetus due either to Rh or major blood group incompatibility; (4) severe liver disease; (5) shock.

Clinically the hemorrhagic diathesis is made known by constant bleeding from the uterus and birth canal with inability of the blood to clot. The appearance of ecchymotic areas on the skin and persistent bleeding from a finger prick or venipuncture should suggest fibrinogenopenia. A rapid bedside qualitative test for the presence of fibrinogenopenia may be made with the withdrawal of 5 ml. of the patient's blood which is then incubated at 37° C. for 30 to 45 minutes.<sup>10</sup> If no clot appears or if at the end of 30 minutes the clot appears to fall apart or disintegrate, the patient's fibrinogen level is critically low. A blood fibrinogen level may be determined; however, this laboratory procedure requires time and may delay therapy. More recently the Schneider fibrin titer assay<sup>14</sup> has been used by one of us (A. S.)<sup>16</sup> with success.

The following case reports demonstrate fibrinogenopenia associated with some of the above-mentioned obstetric complications.

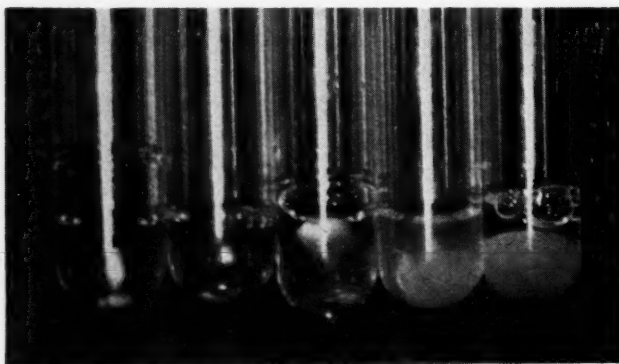


Fig. 1 (Case 1, Patient I. R.).—Serial plasma recalcification time, taken four hours and one hour before intravenous fibrinogen (2.0 Gm.) and then one, two, and nine hours after fibrinogen was given (left to right). Shows smallness of fibrin clot before and presence of adequate fibrin clot after fibrinogen administration.

CASE 1.—I. R., a 37-year-old para i, gravida ii, whose estimated date of confinement was Feb. 20, 1952, was admitted to Flushing Hospital on Feb. 20, 1952, in active labor at 2:10 P.M. Her previous pregnancy in 1951 was uneventful. There was no past history of any hematologic disorder nor liver disease. The present pregnancy was complicated by sudden fetal death at about 30 weeks' gestation with no apparent reason for the death. X-rays of the abdomen were consistent with fetal death, showing overriding of the fetal skull bones. Her remaining antenatal period was uneventful. The patient's blood type was O R<sub>1</sub>R<sub>2</sub> and her husband was B R<sub>1</sub>r. Spontaneous delivery of a macerated stillborn infant occurred shortly after admission to the hospital without any anesthesia at 2:20 P.M. The placenta and membranes were expressed intact at 2:25 P.M. and 1 ml. of Ergotrate was given intravenously. The uterus contracted well. The first stage of labor lasted 10 hours, the second stage 15 minutes, and the third stage 5 minutes. Shortly after delivery, at 2:35, it was noted that the patient was bleeding considerably from the uterus. There were no clots and no clot formation of this blood occurred. The uterus remained contracted while the bleeding continued. Examination of the birth canal under general anesthesia failed to reveal any obstetrical cause for the bleeding. However, the uterine cavity was packed with 20 yards of Hemopack at 3 P.M. The estimated blood loss was approximately 800 ml.



Immediate transfusion with type O Rh-negative whole blood was started, the patient being in impending shock with a blood pressure of 90/60, and a pulse rate of 100. At 4 P.M., she was bleeding through the Hemopack at a rate of about 100 ml. per half hour. Blood pressure was 90/60, pulse rate was 100, and transfusions were running in both arms. At 5:30 P.M., a total of 3,000 ml. of whole fresh blood had been administered. The blood given was less than 24 hours old. The patient's condition continued to become progressively worse as the bleeding continued. In a desperate attempt to reduce the bleeding surface, at 6:25 P.M., a subtotal hysterectomy was performed under cyclopropane anesthesia. At operation, the uterus was noted to be intact and contracted around a well-packed uterine cavity, the cervical stump was oozing from all its surfaces with no definite bleeding points, similarly all layers of the abdominal wall were oozing blood. This hemorrhagic diathesis was even demonstrable from a finger prick which required a pressure dressing. Postoperatively the patient's condition remained critical. Whole fresh blood was continuously administered intravenously, 60 mg. of vitamin K was given at 7:30 and 8:30 P.M. and 10 ml. of 10 per cent calcium gluconate at 8:30 and 11 P.M. The patient's general clinical and hematologic status was very poor until 2.0 Gm. of fibrinogen was given at midnight (Table I). Vaginal and wound bleeding stopped immediately. Her condition gradually improved and she was discharged from the hospital on the seventh postoperative day.

TABLE I. CASE 1, PATIENT I. R.

DATE	BLEEDING TIME (MIN.)	COAGULATION TIME (MIN.)	PLASMA 56° FOR 30 MIN.	PROTHROMBIN TIME WHOLE DILUTE (SEC.)	PLATELET COUNT PER C.MM.	CLOT QUALITY	
2/20/52 2:20 P.M.			(Delivered)				
3:10	10	Incoagulable	Almost no ppt. plus- minus	28	No clot	75,000	Ragged, heavy cell sediment
3:30			(3,000 ml. whole blood)				
5:30	12	10	Almost no ppt. plus- minus	26	No clot	100,000	Ragged, heavy cell sediment
6:40	10	8	Light ppt. +	25	100	100,000	Ragged, heavy cell sediment
8:45	5	10	Light ppt. +	16	150	-	Heavy cell sediment
11:30	2' 45"	12	Almost no ppt. + -	20	170	155,000	Very poor clot
2/21/52 12:30 A.M.			(2.0 Gm. fibrinogen intravenously)				
1:30	2' 30"	7	Heavy ppt. ++++	14	32	135,000	Excellent clot
2:30	2	6	Heavy ppt. ++++	14	33	-	Excellent
9:00	2' 15"	9	Moderately heavy +++	17	51	130,000	Very good
2/22	2	8	+++	17	100	200,000	Good
2/23	2	7	Moderate ++	16	50	250,000	Excellent
2/24	-	6	Moderately heavy +++	15	35	-	Excellent
2/25	2	5	+++	15	32	375,000	Excellent
2/26	2' 30"	5	+++	14	34	440,000	Excellent
3/25	2	9	Heavy +++++	15	27	425,000	Excellent

The laboratory data are summarized in Table I. Fibrinolytic activity could not be demonstrated even after 24 hour incubation of blood group compatible clots with the

patient's serum at room temperature or at 37° C. The patient was found to be type O, Rh positive  $\frac{DCe}{DcE}$  R<sub>1</sub>R<sub>2</sub>. The anti-B agglutinin titer was 1:1,280. Anti-A antibodies were present only to a titer of 1:128. No other saline agglutinin or blocking antibodies could be demonstrated in the maternal serum. The indirect Coombs test was also negative. The test cells used were pooled O Rh-positive cells obtained from seven male blood donors. The husband's blood type was type B, Rh positive  $\frac{DCe}{fce}$  R<sub>1</sub>r. Unfortunately, no studies were made on the fetus and cord blood was not available.

CASE 2.—C. S., a 24-year-old white primigravida, whose estimated date of confinement was March 20, 1951, was admitted to the hospital on March 10, 1951, in early labor. The membranes were intact. The patient was type B, Rh positive. Her prenatal course had been uneventful until 24 hours prior to admission when she developed a generalized icterus. There were no signs nor symptoms of toxemia. A diagnosis of infectious hepatitis complicating pregnancy at term was made. At the time of admission, a generalized icterus was present and there was bleeding from the anus and gums. Shortly after admission, the cervix was fully dilated and she was delivered spontaneously with a second-degree laceration and repair. About one hour following delivery excessive bleeding from a well-contracted uterus was noted. Venipuncture was followed by oozing from the site and sustained direct pressure was necessary to control external ooze and subcutaneous hematoma formation. Five ml. of the patient's blood was incubated at 37° C. for one-half hour. Very poor clot formation occurred with almost complete disintegration of the clot after a half hour. A diagnosis of fibrinogenopenia was made. This was thought to be secondary to severe hepatic damage. Two Gm. of pure dehydrated fibrinogen diluted in 500 ml. of normal saline was administered intravenously followed by 2,000 ml. of whole fresh blood. The patient's response was excellent and the uterine bleeding ceased within an hour. The patient's condition gradually improved allowing her to be discharged from the hospital on the thirteenth postpartum day. Laboratory data are summarized in Table II.

TABLE II. CASE 2, PATIENT C. S.

1951	3/10	3/12	3/15	3/16	3/19	3/21
R.B.C.	4,360,000					2,650,000
Hemoglobin	14.5 Gm.					9.6 Gm.
W.B.C.	11,850					12,300
Urine, protein	2+					
Icteric index		40	42		24	
Prothrombin time		15 seconds				15 seconds
Urine, bile		Pos.	Pos.	Faint trace		
Urine, urobilinogen		Neg.	Neg.	Pos. 1:10		
Alkaline phosphatase		18 Bodansky units				4.5 Bodansky units
Cephalin flocculation		3 plus at 24 and 48 hours				2 plus at 48 hours

CASE 3.—L. D., a 24-year-old white primipara, was admitted to the hospital at term on June 1, 1952, because of continuous abdominal pain and severe pre-eclampsia. Physical examination upon admission at 1 A.M. revealed a blood pressure of 180/130, and 1 plus ankle edema. The uterus was hard and tender, no fetal heart sounds could be heard, and there was moderate vaginal bleeding. Urine analysis revealed 4 plus albumin. The patient's blood type was A, Rh positive. Her blood revealed poor clot formation although a Lee-White coagulation time determination was 7 minutes. The blood fibrinogen level was 174 mg. per cent. The clot disintegrated within 15 minutes when incubated at 37° C.

A diagnosis of abruptio placentae associated with severe pre-eclampsia was made. She was taken to the operating room where a classical cesarean section was performed at 4:45 A.M. At operation a Couvelaire uterus was found, the fetus was stillborn, the placenta was ap-

proximately 50 per cent separated with large clots in the uterus, and there was some oozing from all the surgical surfaces. The uterus did not contract well. However, because of the age and parity of the patient, a hysterectomy was not performed. Her immediate postoperative condition was poor as blood continued to ooze through the abdominal wound and blood pressure readings ranged from 90/60 to 70/50 and pulse was 110 per minute. Although repeat bedside Lee-White coagulation time determinations were normal, clot lysis remained prominent. There was complete lysis of the blood clot after four hours' incubation at 37° C. The prothrombin time and the dilute (1:8 saline) prothrombin times were 15 seconds (control 13) and 38 seconds (control 30), respectively. Fibrin precipitate was estimated at 3 plus (low normal value). The blood fibrinogen concentration at this time was 205 mg. per cent. This determination was actually performed 18 hours after the blood was drawn. Platelets were 300,000 per cubic millimeter and bleeding time was normal.

The patient received 1,500 ml. of citrated whole blood over the next six hours.

Her condition gradually improved and her blood pressure and pulse readings returned to normal. The hemorrhagic diathesis had stopped by the following morning. A further 1,000 ml. of blood and 300 ml. of plasma were administered during the following 12 hours. Daily doses of vitamins C and K were given and 1,000 ml. of whole blood 48 hours later, and all hematologic values were normal at this time except for mild anemia. The remaining postoperative recovery was uneventful, allowing her to be discharged on the fourteenth postoperative day. The clinical diagnosis was abruptio placentae with hypofibrinogenemia and fibrinolysis.

CASE 4.—V. T., a 32-year-old white para ii, gravida iii, was admitted to Flushing Hospital May 26, 1952, complaining of continuous abdominal pain. Her estimated date of confinement was Aug. 18, 1952. Past obstetrical history revealed that her first pregnancy was terminated at 37 weeks' gestation by cesarean section because of a placenta previa. Her second pregnancy was complicated by a partial premature separation of the placenta at 26 weeks' gestation. The infant weighed 1 pound, 14½ ounces, and died shortly after birth of prematurity. Upon admission to the hospital at 1:25 A.M., the patient was complaining of continuous abdominal pain of one hour's duration. Physical examination revealed the blood pressure to be 130/100. The uterus was 2 fingerbreadths above the umbilicus, hard and tender. Heavy vaginal bleeding was also noted. A low classical cesarean section was performed at 2:10 A.M. The placenta had completely separated and the uterus was full of blood clots. A premature stillborn male infant was delivered. The uterus contracted well after its closure. The free blood in the peritoneal cavity appeared very watery and no clot formation was noted. After the skin had been closed there was moderate oozing of blood through the abdominal incision. About 5 hours later, the patient was returned to the operating room because of profuse oozing of blood through the abdominal incision. Upon exploration, no definite bleeding points could be found; however, there was generalized oozing from all surgical surfaces, and it was noted that the blood did not clot. The incision was closed and the patient returned to her room. A 5 ml. sample of her blood was incubated at 37° C. for 30 minutes, revealing formation of an extremely poor clot which almost completely disintegrated upon gentle manipulation. A diagnosis of hypofibrinogenemia was made. About 1,500 ml. of citrated whole blood, type O, Rh negative, had been administered during the night prior to her return to the operating room. The wound continued to ooze blood. The blood pressure was 100/58, pulse 76. At 2:45 P.M. (12 hours postoperatively) 500 ml. of whole fresh blood, 100 mg. of vitamin C, and 60 mg. of vitamin K were given. No improvement was noted. The bleeding time was 6 minutes, the Lee-White coagulation time was 28 minutes. A clot which formed was poor, ragged, and easily broken down. No fibrinolysin could be demonstrated at either 37° C. or room temperature, even after 48 hours' incubation. Prothrombin time was 20 seconds (control 14) and the dilute (1:8 saline) prothrombin time, infinite seconds (control 28 seconds). The platelet count was 110,000 per cubic millimeter. The fibrin precipitate was only 1 plus and the fibrinogen concentration, 95 mg. per cent.

Two Gm. of fibrinogen dissolved in 150 ml. of saline was given intravenously. One hour later, blood specimens revealed good clot formation. An additional 500 ml. of fresh whole blood followed the fibrinogen administration. Vitamins C and K were given daily by mouth. On the third postoperative day, evisceration took place. Secondary closure was done without incident. There was no defect in the clotting mechanism at this time and the laboratory values were within normal limits. The patient gradually recovered and was discharged from the hospital on the eleventh postoperative day.

### Comment

The presentation of four cases of severe postpartum hemorrhage associated with a coagulation defect successfully treated highlights the importance of recognition of this syndrome. Once the diagnosis is suspected, it must be proved and therapy planned and executed with dispatch.

All patients who exhibit severe toxemia, signs of premature separation of the placenta, dead fetus, high titer isoimmunization due to either Rh or ABO sensitization with possible dead fetus, or, finally, severe hepatic damage, may have a fibrinogenopenia. Antepartum studies of the coagulation mechanism may fail to reveal any defect, but with the onset of labor serial observations of the coagulation time, clot quality, and the fibrinogen blood level must be carried out. The use of the coagulation test alone may leave the obstetrician with a false sense of security and some method similar to Schneider's<sup>14</sup> fibrin titer assay is recommended. Furthermore, the aid of the hematology service should be sought in the management of the problem. Fibrinogen administration is the most direct means of restoring the blood fibrinogen level to normal and re-establishing the integrity of the clotting mechanism. However, this plasma protein fraction is not always available. Apparently, its production and distribution are complicated by the associated presence of the virus of homologous serum hepatitis. Follow-up studies of the three patients we are reporting who received fibrinogen have not revealed the presence of serum hepatitis. Where fibrinogen is not readily available, fresh whole citrated blood and fresh plasma may be used. If plasma is used, the operator must be certain that the fibrinogen has not been removed during the processing of the plasma. Usually, 2 to 6 Gm. of fibrinogen are necessary for rapid restoration of blood levels but frequently the lesser dose, together with adequate fresh blood replacement, will suffice. Each 500 ml. of whole blood contains approximately 500 mg. of fibrinogen. Caution must be exercised in the administration of blood and plasma that, in the effort to replace fibrinogen, cardiovascular dynamics are not compromised.

The exact cause of the coagulation defect is still not completely clear although there is little question that the high concentration of thromboplastic substance in the placenta and decidua is of paramount importance. However, the role of the fibrinolysin, so active in Case 3 but not demonstrable in the other patients, is not known. Spontaneous bruising and a prolonged bleeding time are not prominent signs. Moderate thrombocytopenia, however, was present in two patients (Cases 1 and 4). This transient thrombocytopenia has been noted by one of us (A. S.) among five other patients with hypofibrinogenemia.<sup>16</sup> The possibility of intravascular platelet agglutination and subsequent peripheral thrombocytopenia is thereby suggested. Similar experimental thrombocytopenia



was demonstrated by Schneider<sup>15</sup> when dogs were subjected to sublethal intravenous injection of meconium. The blood of these animals became incoagulable presumably due to the release of an anticoagulant substance since the fibrinogen and other protein plasma components of coagulation remained normal.

### Summary

1. Four cases of severe postpartum bleeding associated with coagulation defect are presented.
2. Transient hypofibrinogenemia was present in all patients at the height of the bleeding diathesis.
3. The serum of one patient showed transient but marked fibrinolytic activity.
4. In two patients, transient thrombocytopenia was noted.
5. Intravenous fibrinogen caused prompt return of the coagulation mechanism to normal.
6. The removal of the uterus and its contents does not ensure rapid correction of the coagulation defect. Additional fibrinogen is frequently necessary.
7. All patients in whom a diagnosis is made of severe toxemia of pregnancy, premature separation of the placenta, marked isoimmunization in pregnancy, presence of a dead fetus, or severe hepatic damage should be screened for the possible development of afibrinogenemia at the time of delivery.

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## PUERPERAL HEMATOMAS\*

### Report of 73 Cases and Review of the Literature

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**P**UERPERAL hematomas represent postpartum collections of blood in the perigenital connective tissue and are the result of the rupture of a blood vessel or of blood vessels.<sup>1</sup> Such blood tumors are unusual and often frightening. They may be difficult to diagnose, tedious to treat, and, occasionally, ominous in portent.

The obstetrician's immediate embarrassment upon discovering such a hematoma in one of his own patients may be somewhat dissipated by study of the pertinent literature. It is noted that this problem may occur before, during, or after either spontaneous or operative delivery, in cases with or without episiotomies or lacerations, in toxemic and nontoxemic patients and in subjects with or without blood dyscrasias.<sup>2</sup>

However, despite the apparent widespread distribution of situations in which perigenital blood collections may occur, the reported number of cases is few (187 cases up to 1949) and the literature is limited. Rueff reported a case in 1554 that is generally regarded as the first recorded instance of this situation<sup>3</sup> and Deneux in 1830 first studied the problem in detail.<sup>4</sup> Some of the significant recent contributions to this subject have been those of Hamilton,<sup>3</sup> Walsh and Ganser,<sup>1</sup> Duckman and Tortora,<sup>2</sup> Shull and Thoms,<sup>5</sup> and Lyons.<sup>6</sup>

It will be our purpose to review the pertinent modern literature and to gather in one communication a total listing of the diagnostic features and therapeutic suggestions that have been presented in the past decade concerning this problem. We shall also present 73 instances of puerperal perigenital hematomas not previously reported and discuss the significant clinical aspects of these cases.

Puerperal perigenital bleeding may occur *under* the vulvar skin, *around* the vagina, *under* the broad ligaments or *into* the broad ligaments. The dissection of blood tends to follow the natural cleavage lines of connective tissue and fascia. If the bleeding occurs above the pelvic fascia and the levators, it may extend into the false pelvis under Poupart's ligament or further retroperitoneally into the renal or subdiaphragmatic areas.<sup>8</sup> These hematomas may be immediate in their occurrence or require not only hours, but days, and even weeks for their full formation.<sup>9</sup>

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These lesions are then: immediate or delayed, static or expanding, apparently spontaneous or obviously traumatic. Occasionally, if prepartum and massive, they may cause dystocia. Lyons<sup>6</sup> has suggested the subdivision of these puerperal hematomas into vulvar, paravaginal, intraligamentous, or retroperitoneal varieties, or any combination thereof. McNally and Ehrlich<sup>10</sup> have recently subdivided the vulvar varieties into perineal, ischiorectal, and labial.

### Incidence

The frequency of puerperal hematomas of the paravaginal and vulvar varieties has been variously stated as follows: Eastman,<sup>4</sup> 1 in 1,500 to 2,000 deliveries; Moshkow, 1 in 1,951 deliveries<sup>1</sup>; Williams, 1 in 2,000 deliveries<sup>1</sup>; DeLee and Greenhill, 1 in 4,000 deliveries<sup>1</sup>; Michaels and Herring, 1 in 5,474 deliveries<sup>1</sup>; and Duckman and Tortora,<sup>2</sup> 1 in 12,495 deliveries. Shull and Thoms<sup>5</sup> feel that the vulvar variety is not rare and usually not serious. Less frequent, in their opinion, are vaginal hematomas. Regarding the retroperitoneal hematomas, Lyons<sup>6</sup> recalls the report of Williams wherein 33 cases were discussed (22 of these prior to 1880) with a mortality of 73 per cent. DeLee<sup>7</sup> felt the mortality in this retroperitoneal subdivision reached 40 per cent prior to the institution of active therapy.

Among the factors responsible for the discrepancy in incidence statistics are the following: (1) Some puerperal hematomas are small and insignificant.<sup>1</sup> (2) The diagnostic acumen of the different attendants and their interest in this problem varies. (3) Perhaps the most important item is the basic issue of definition.<sup>11</sup> If we discuss only the massive variety—those with profound anemia, with marked retroperitoneal extension, or those producing severe morbidity or mortality—then, the condition is rare. If, contrariwise, we tabulate the very small hematomas that are often observed when a superficial vessel is injured during an episiotomy repair for which we occasionally insert a mattress suture—then, these hematomas are an everyday problem.

### Etiology

Although specific etiological factors cannot be identified in many cases, it is of interest to tabulate those causative items proved or postulated by previous authors.

1. *Excessive trauma* is thought to be responsible for some of the early cases.<sup>6</sup>
2. *Improper hemostasis*.<sup>11</sup>
3. *Pressure necrosis* of the affected vessels is thought to be responsible for some of the delayed cases.<sup>6</sup>
4. *Primigravidas*, particularly young patients, are thought to be more disposed to this disorder.<sup>1, 3, 4, 6, 10</sup>
5. *Toxemia*.<sup>1, 6</sup>
6. *Blood dyscrasias* are said to increase the incidence of hematomas.<sup>6</sup> An unknown hematologic factor was postulated by Hamilton.<sup>3</sup>
7. *Varicosities* of the genital area may rupture.<sup>6</sup>
8. *Too vigorous uterine massage* in the therapy of postpartum hemorrhage may cause small hematomas in the subperitoneal connective tissue and in the broad ligaments.<sup>7</sup>

9. *Excessive dosage of pituitary extract* has been incriminated.<sup>11</sup>
10. *Persistent occipitoposterior positions of the fetus* have occurred with increased frequency in association with hematomas in certain series.<sup>12</sup>
11. *Large babies* have similarly occurred with increased frequency in some series,<sup>12</sup> and no more frequently in others.<sup>10</sup>
12. *Prolongation of the second stage of labor.*<sup>10</sup>
13. *Incomplete rupture of the uterus or unnoticed or improperly repaired cervical lacerations may be observed* in the subperitoneal variety.<sup>5</sup>
14. *Edema without toxemia and infection* were noted as associated complications more frequently than might be anticipated in one series.<sup>10</sup>
15. *Failure to follow certain of the preventive measures* which will be subsequently listed should also be regarded as etiological factors.<sup>2</sup>

### Diagnosis

In a consideration of the diagnostic features of puerperal hematomas, the following signs and symptoms must be discussed.

1. *Pain.*—Severe and even excruciating pain is the most prominent symptom and the occasional patient may even describe the tearing asunder of tissue.<sup>7</sup> The pain is often not relieved by reasonable doses of opiates and becomes progressively more severe.<sup>3</sup> Cases are missed in the formative period because the obstetrician attributes the discomfort to ordinary episiotomy distress.<sup>6</sup> Patients will often describe intense rectal discomfort and this complaint should direct our thoughts to possible hematoma formation. In one of the cases of Walsh and Ganser,<sup>1</sup> a vivid description of the patient's agony is given when they state, "examination at that time revealed a patient screaming like a wounded animal, with an ashen face and a slow pulse of good quality." In one of our recent cases, the diagnosis was suggested to us by the finding (one hour post partum) of a grossly disoriented patient who was wildly screaming and attempting to crawl to the floor.

2. *Tumor.*—In the vulvar and vulvovaginal varieties, the sudden appearance of a tense, elastic, and tender mass of varying size, possibly covered by discolored skin or mucosa is typical.<sup>4</sup> In the vaginal type, rectal or vaginal examination will usually show a unilateral swelling often encroaching on the ischiorectal fossa and partially or totally obliterating the vaginal lumen.<sup>4, 13</sup>

3. *Shock.*—The classic signs of shock may appear because of the pain and/or blood loss.

4. *Fever.*—A persistent, low-grade elevation of temperature with a corresponding increase in the pulse rate is often noted in the cases with delayed diagnosis.<sup>11</sup>

5. *Anemia.*—Anemia may play an important part in the clinical picture.<sup>7</sup> Particularly is this true in the subperitoneal variety.<sup>4</sup>

6. *Additional Signs and Symptoms.*—*Ileus with distention*, severe *thigh pain* on the affected side,<sup>14</sup> and unilateral *leg edema* due to circulatory disturbance by compression have been reported in the subperitoneal varieties.<sup>3</sup>

Walsh and Ganser discuss differential diagnosis. They list prolapse of the cervix, threatened or actual rupture of the uterus, and shock as differential entities.

### Treatment

As with most medical problems, the best treatment is prevention. Possible preventive techniques may be summarized as follows:



A. *Prior to Delivery.*—

1. Meticulous prenatal care with particular attention to the management of anemia.
2. Adequate treatment of toxemias and the recognition and treatment of blood dyscrasias.<sup>16</sup>

B. *At Delivery.*—

1. The practice of gentle and definitive obstetrics and the use of special care in the presence of vulvar varicosities are to be listed as part of the preventive regimen.<sup>16</sup>
2. An adequate episiotomy should be performed.
3. The episiotomy should be regarded as a surgical wound and treated with the utmost respect. Among the specific factors to be borne in mind during an episiotomy repair are:
  - a. Careful inspection of the cervix and vagina for lacerations.<sup>6</sup>
  - b. Good tissue approximation.<sup>6</sup>
  - c. The ligation of definite bleeding points.<sup>15</sup>
  - d. The placement of the first suture above the upper angle of the incision.<sup>15</sup>

C. *Post Partum.*—

1. The very *possibility* of hematomas occurring as a postpartum complication and the desirability of treating small and expanding hematomas as they begin to form should be noted.<sup>8</sup>
2. More attention should be directed to the perineum in the first few hours of the puerperium. It is wise to examine the perineum first rather than hastily to prescribe analgesics for inordinate pain. The patient's complaints must not be ignored. The significance of undue perineal pain is enhanced in the early puerperium if it is remembered that the analgesia and anesthesia may still be operative. These patients are in pain despite such medication. Early recognition is essential.<sup>2</sup>

The consensus of modern opinion regarding management of hematomas may be stated as follows<sup>1, 4, 7, 9, 13</sup>:

- A. If a hematoma begins to form during labor and is rapidly growing, incise, obtain hemostasis by any available technique, pack if necessary, and perform vaginal delivery at this time if feasible.
- B. If a hematoma begins to form before the placenta is delivered, delivery of the placenta by the most appropriate method is indicated. Definitive therapy of the hematoma may then be undertaken.
- C. If a hematoma is found after delivery, which is the usual course, the management follows one of two patterns:
  1. *Expectancy.*—Expectancy is indicated if the tumor is small and self-limited. The treatment should consist of ice packs; the application of pressure (a broad and tight T-binder exerting pressure on the perineal tissue with a piece of sponge rubber is most satisfactory); rigid antisepsis; sedation; and intelligent observation. Mengert<sup>13</sup> observes that conservatism probably produces better results. If one of these smaller hematomas subsequently becomes infected, it should be opened and drained.
  2. *Active Therapy.*—If a tumor is expanding or of large size when first discovered, active management is necessary.
    - a. The tumor should be opened widely. Incision through the most accessible area seems logical, e.g., reopening of an episiotomy

wound. Hamilton, however, has specifically stated that incision through the vaginal mucosa into the hemorrhagic cavity is preferable.<sup>3</sup> A technique of evacuating these hematomas that seems eminently logical to us is a technique that obtains as precise and total hemostasis as is possible as the exposure is developed, i.e., bleeding in the subcutaneous area is controlled in toto and then, as the incision is deepened, hemostasis is developed in "layer by layer" fashion. In this way, the bleeding is not as overwhelming as it is if a deep incision into the hematoma is made at the onset.

- b. Clots should be evacuated.
- c. Hemostasis should be obtained in the depths of the wound, if possible, by any ligature or suture technique that is feasible, i.e., ligature, suture ligature, mattress suture, etc.
- d. Closure of the wound in anatomic fashion should be effected if possible.
- e. If total hemostasis and anatomic closure cannot be accomplished, a tight pack should be inserted into the cavity. This should be removed by stages after remaining in place for at least 24 hours.
- f. The uterovaginal canal should be tightly packed for the purpose of counter pressure. This packing should be removed in 12 to 24 hours.<sup>3</sup>
- g. The procedures itemized under *expectancy* (above) should be instituted.
- h. Blood replacement is to be continued or begun as the situation demands.
- i. Broad-spectrum antibiotic therapy should be instituted.

Hamilton<sup>3</sup> has been among the foremost advocates of an active approach in all instances.

Other therapeutic suggestions that have been presented in the literature are as follows:

1. *Aspiration* may occasionally be feasible. The possibility of infection with this technique is said to be significant.<sup>12</sup>
2. The importance of using an *interrupted-suture* technique when closure is performed has been emphasized.
3. The use of *hemostatic gauze* has been suggested. The actual sewing of such gauze into the wound with interrupted sutures has also been proposed.<sup>17</sup> Occasionally, this material will cause considerable inconvenience by failing to be absorbed. This may result in a persistent discharge for some period of time.<sup>18</sup>
4. If active bleeding is encountered in the rectovaginal septum, a firm *pack in the rectum* for counter pressure against a uterovaginal pack may be helpful.<sup>15</sup>
5. *Proper drainage* at the proper time if the hematoma has become infected may expedite the ultimate solution of a hematoma problem.<sup>6</sup>
6. Diathermy at a later date may aid in the ultimate resolution of a hematoma and softening of excessive scar tissue.<sup>14</sup>
7. A *secondary perineorrhaphy* may be required<sup>6</sup> although excellent recovery of normal anatomy is the general rule.<sup>10</sup>
8. In the large subperitoneal varieties, *prompt laparotomy* is required. Hemostasis must be obtained by whatever means are available, which might well include hysterectomy.<sup>4</sup>

9. Recently, utilization of the principle of *enzymatic débridement* by use of streptokinase and streptodornase has been proposed for the management of hematomas and soft-tissue abscesses, and favorable results have been noted.<sup>19</sup> If anatomic closure of the hematoma cavity has not been possible and a pack has been used for hemostasis, daily irrigation of the cavity after the pack has been removed, with a solution such as Dakin's, is frequently helpful.
10. Dodek<sup>20</sup> suggests that the *use of curare* with general anesthesia offers such excellent perineal relaxation that a reduction of hematoma incidence should be expected.

### Prognosis

The maternal mortality rate in the paravaginal and vulvar types has been variously stated to be from 0 to 9 per cent to 21 per cent,<sup>3</sup> and in the subperitoneal variety once reached 56 per cent<sup>7</sup> to 73 per cent.<sup>6</sup> Eastman<sup>4</sup> states that fatal issue occasionally occurs in the subperitoneal variety with secondary rupture into the peritoneal cavity but that the prognosis is usually favorable. In these rare cases where death occurs, the causative factors are hemorrhage, shock, and infection. He further states that vulvar hematomas of even moderate size usually absorb spontaneously but, occasionally, the tumor-covering tissue may undergo pressure necrosis and give way, with resultant hemorrhage.

DeLee and Greenhill<sup>7</sup> state that it is wise to make a guarded prognosis until it is determined how far the hematoma has burrowed and whether or not infection will occur.

Hamilton<sup>3</sup> states that, in his series, managed in active fashion, follow-up examinations showed practically no residual distortion of tissues. Even some of the larger hematomas that are managed by packing alone heal with minimal distortion and almost inevitably with perfect or near-perfect function.<sup>11</sup> Lyons postulates that more blood tumors of the delayed variety may be seen because of the trend toward early ambulation.

In our opinion, the issue of residual pain has not been adequately discussed in the literature. We know of several instances wherein healing was apparently complete but pelvic, vaginal, or perineal pain has persisted.

### Clinical Data

We have reviewed the instances of puerperal hematomas in two of the hospitals with which we are affiliated for a period slightly in excess of ten years ending March, 1952. During this time, 40,932 deliveries have been conducted and 73 puerperal hematomas have occurred. This is an over-all incidence of 0.18 per cent or 1 hematoma per 561 deliveries. We are reporting those instances in our own practice wherein "the hematomas were sufficiently troublesome or large enough to be dignified by this diagnosis."<sup>11</sup>

We have divided our cases as follows: (1) vulvar, 33 cases, (2) vulvovaginal, 22 cases, (3) vaginal (paravaginal), 11 cases, and (4) broad ligament, 7 cases. Groups 1 and 2, comprised of 55 cases (75 per cent), represent the number wherein the diagnosis could be made by simple inspection of the perineum. In the remaining 18 patients (25 per cent), bleeding was concealed. The latter group was more of a diagnostic problem.

The average age of the patients in this study was 27.1 years. There were only 4 patients who were 36 years of age or older. The majority of the cases were seen in the obstetrically prominent third decade.

No maternal deaths occurred. The uncorrected perinatal mortality was 1.4 per cent. One 1,800 gram infant, the first of twins, died because of esophageal atresia.

Clinical morbidity, by the accepted definition, was present in 27 (37 per cent) cases. The average period of morbidity (for the morbid group) was 5.6 days. The usual hospital stay for these two institutions approximates 7 to 8 days. This was unchanged for 31 patients (43 per cent) in this series. The average stay for all patients was 10.1 days, the shortest being 4 days and the longest 30 days. Over one-half of the entire group (57 per cent) experienced prolonged hospitalization.

Forty-three (59 per cent) of these 73 women experienced puerperal hematomas following their first delivery, the incidence being significantly lower in the multigravid group. Eighty-two per cent of the entire group were either primigravidas or secundigravidas.

The length of labor did not appear to be of significance. In 60 cases (82 per cent) labor was 12 hours or less in duration. There were 12 instances of labor lasting between 13 and 24 hours and there was only one labor in excess of 24 hours. In the Evanston series (48 patients), 12 had a second stage of labor over one hour but only one patient had a second stage lasting over two hours.

Forceps were applied to infants that presented by the vertex in 52 instances (73 per cent) in this series. Forty-two deliveries were by low forceps operations and 10 by midforceps. The latter included 6 forceps rotations and 2 manual rotations. Those operations designated as midforceps procedures fulfilled the criteria of the older definition. There were 3 breech deliveries. One of these was facilitated by forceps delivery of the aftercoming head. There were also 18 spontaneous deliveries. Instrumental deliveries are relatively common at the Evanston Hospital, frequently exceeding 65 per cent of all deliveries.

Episiotomy was used in 68 cases (93 per cent). The majority of these were left mediolateral in type. In 6 instances, a notable degree of extension was recorded. Among the 5 patients without episiotomy, only one was a primigravida.

General anesthesia was used 48 times (66 per cent), and spinal anesthesia 24 times (33 per cent). The average duration of general anesthesia was 34.3 minutes, with only one case exceeding one hour (71 minutes). Spinal anesthesia was not used at Butterworth Hospital. Local anesthesia was not used in this series.

Six infants weighed in excess of 4,000 grams and one infant was hydrocephalic. Therefore, approximately 10 per cent of the infants were larger than average or presented larger than average fetal head diameters. Pre-eclamptic toxemia was present in 3 cases (4.1 per cent). Hypertension (140/90 mm. Hg) without edema or albuminuria was seen in 4 cases (5.5 per cent). Only one patient had significant vulvar varicosities. No blood dyscrasias were diagnosed.



Regarding diagnosis, a mass was almost universally present. Sixty patients (82 per cent) complained of varying degrees of pain. This was classified as minimal in 7 instances, moderate in 26, and severe in 10. A specific and localized description of rectal pain was furnished by 17 patients. Forty-four patients (60 per cent) exhibited a febrile response at some time during their hospital stay. Shock was a major finding in 4 cases. External bleeding was found in only 2 cases. The hematomas were asymptomatic in 9 instances.

The time of occurrence post partum was rather precisely recorded in most instances. Twenty-nine hematomas (40 per cent) were diagnosed within 12 hours of delivery with an additional 8 (total 37) being noted in the following 12 hours. Half of the hematomas, then, were diagnosed within 24 hours of delivery; 8 more hematomas were observed during the second 24 hour period; 27 diagnoses were made from the third to the eighth postpartum day; and, in 3 instances, the lesion was not discovered until after the eighth postpartum day. The longest interval between delivery and diagnosis was 54 days.

Regarding therapy in this study, 37 patients (50.7 per cent) were treated conservatively and 36 (49.3 per cent) were managed by various types of surgery. Table I indicates the surgical methods utilized.

Packing was utilized in some form in 11 of these 36 patients. One patient of the surgical group was twice returned to the operating room on an emergency basis. Another visited the operating room three times for the changing of a pack. However, only one of these latter visits was on an emergency basis. One patient was subjected to laparotomy as a result of failure to diagnose a hematoma of the right broad ligament. The preoperative diagnosis in this instance was acute appendicitis.

Blood transfusion was utilized in 27 patients (37 per cent) in this series. Seven of the patients who received blood are grouped with those cases treated conservatively, i.e., no *local* management of the hematoma was necessary and the blood was given to correct anemia. Twenty of the patients who were transfused required surgical management as described in Table I. The average amount of blood administered to the group of transfused patients was 950 c.c. The greatest amount of blood given to any single patient was 2,500 c.c.

TABLE I. SUMMARY OF TREATMENT

Conservative treatment	37 cases	(50.7%)
Surgical treatment	36 cases	(49.3%)
Evacuation and suture (primary closure)	10 cases	(27.7%)
Evacuation and drainage	6 cases	(16.6%)
Evacuation, suture and pack	6 cases	(16.6%)
Evacuation and pack	5 cases	(13.9%)
Evacuation, suture and drainage	4 cases	(11.1%)
Probing and/or aspiration	4 cases	(11.1%)
Laparotomy (misdiagnosis)	1 case	(2.8%)

Study of the 7 cases of broad ligament hematomas (Table II) revealed that delay in diagnosis often occurs in this group and that the morbidity and length of hospital stay are significantly increased. It was also noted that more blood replacement was required for these patients. No patient in the broad ligament

series required surgical intervention for the hematoma problem. One patient was submitted to surgery through an error in diagnosis as noted above.

TABLE II. HEMATOMAS OF THE BROAD LIGAMENT

CASE NO.	POSTPARTUM DAY OF DIAGNOSIS	MORBIDITY (NO. OF DAYS)	HOSPITAL STAY (NO. OF DAYS)	TRANS-FUSION	UNUSUAL SYMPTOMS
1	11th	13-	13	1,000 c.c.	
2	4th	11	19	1,000 c.c.	Dysuria
3	54th	2	7	1,000 c.c.	Groin pain
4	2nd	1	9		R.L.Q. pain
5	4th	12	16	1,000 c.c.	Low back pain
6	3rd	7	16		Rectal pressure. Buttock pain. Sciatica
7	3rd	3	20		

### Summary

We have reviewed the literature of the last decade relating to puerperal hematomas. We have attempted to compile a total listing of possible causative factors, a total listing of the symptoms which have been reported, and a complete tabulation of the various therapeutic suggestions that have been offered so that these data might be easily available in one communication.

We have studied our own experience and find it in general accord with that of the literature. There was no maternal mortality in our series. One-third of the patients were morbid. Over one-half of the patients were primigravidas. Prolonged labor did not seem to be an etiological factor. We found no prolongation of the second stage of labor in this study. Nonetheless, it seems eminently logical that such prolongation might well increase the incidence of puerperal blood tumors. The type of anesthesia appeared to be of no significance. It is undoubtedly true that saddle block anesthesia may prevent the early complaint of inordinate pain. Obviously, more vigilant postpartum supervision is necessary for these patients.

The incidence of forceps delivery (73 per cent) in this series is much higher than in all but one of the previously reported studies. Hamilton noted an overall operative incidence of 42 per cent in all the cases in the literature. Our high incidence of forceps delivery as well as our high incidence of occurrence suggests to us that trauma may be an important etiological factor. We are compelled, for example, to disagree with the terminology employed by McNally and Ehrlich<sup>10</sup> in their recent publication and with one of their conclusions. They report 52 instances of puerperal hematomas with an incidence of 80 per cent operative delivery (low forceps). This is the only series that has come to our attention with a higher operative incidence than our own. They contend that, with the exception of one breech delivery and 3 patients delivered by the Scanzoni maneuver, "all patients can be considered to have delivered normally" and that trauma is not, therefore, a significant etiological factor. These patients may have delivered in the *usual* fashion, i.e., saddle block anesthesia with low forceps delivery, but not in the *normal* fashion and such statistics (80 per cent operative delivery) most certainly do not exclude trauma as a causative item.

In terms of therapy, it may be unequivocally stated that active management is surely indicated for the expanding varieties.

Not to be obscured by the plea for *conservative obstetrics* (nontraumatic delivery, meticulous episiotomy closure, and precise hemostasis) and the plea for *active therapy*, when indicated, is the important suggestion that the obstetrical diagnostician must be alert to the very *possibility* that this complication may occur. *Delay in diagnosis means needless destruction of tissue.* Early recognition is crucial.

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### Discussion

DR. ROBERT J. HAWKINS.—The cases of puerperal hematomas presented for your consideration this evening are the largest group to be reported up to this time.

Pain is the most outstanding subjective symptom. It is severe, constant, and aggravated by motion. The affected area is swollen, discolored, and distorted; warm to feel, and exquisitely tender to touch. Whenever tissue is acutely distended by fluid, pain is produced. When this distention distorts a recent surgical incision the painful manifestations are increased. A patient with a well-established vulvovaginal hematoma often rebels at a rectal examination because of the pain such an examination produces.

Blood extravasated into tissue acts as a foreign protein and this reaction may account to some degree for the morbidity often accompanying this complication of pregnancy.

In every series of cases reported all authors seem to agree that trauma is the exciting cause. Ninety-three per cent of the cases reported by McElin had episiotomies. This operative procedure was the one condition which the majority had in common and one must conclude that episiotomy with improper episiorrhaphy was the exciting cause in the majority of cases. The mediolateral type of episiotomy was used in most of the cases and involves the more vascular tissue of the perineum and levator muscles. This type of episiotomy will produce a greater number of hematomas than the less vascular median type.

Operative procedures other than episiotomy must be considered in the vaginal and broad ligament type of hematomas.

The authors call our attention to the surgical axiom of complete and thorough hemostasis. With this we agree but I believe there is a marked tendency on the part of all of us to repair episiotomies without attempting to control bleeding. We depend on tissue approximation and

the hemostatic property of muscle tissue rather than ligation of all bleeding points. The same meticulous care should be taken in the repair of episiotomies that would be used in any gynecologic operation.

Routine inspection of the cervix and vaginal tract should be done after all operative procedures, and the immediate repair of any damage will minimize the possibilities of vaginal or broad ligament hematomas.

The prevention of puerperal hematomas is more important than their treatment after they have occurred. Routine inspection of the perineum before the patient leaves the delivery room might lead to the early discovery of the hematoma before it reached any formidable size.

DR. JOSEPH FUNNELL.—I wish to ask if in this group there were many patients who had pudendal block. It seems that we have heard of several instances in which hematomas have developed after the use of pudendal block.

DR. JOSEPH L. BAER.—Forty-five years after the occurrence of the very brief case report which I am about to recite, I think it is time to report it.

With due apologies to the authors, this was an instance not of puerperal hematoma but of intrapartum hematoma which I witnessed when I was attached to the Charité Hospital in Berlin which at the time was under the management of Bumm. The patient was a grand multipara who came into the hospital because the midwife could not deliver her in the home. She was in tumultuous labor. On examination the head was visible in the vulva but the right labium was distended by a hematoma so huge that it completely blocked the egress of the fetal head. Under ether anesthesia the clinician in charge of the clinic at that time proceeded to evacuate the hematoma. He had not counted on the fact that the uterus was still very active in spite of the ether anesthesia. The result was that when he made the linear incision into this mass there suddenly was an enormous gush of all the blood contained in this huge vulvar hematoma plus the precipitate exit of the fetus and placenta so that he and the baby were covered with blood from head to foot. It took three-quarters of an hour for him to accomplish complete hemostasis through the incision. No matter how many ligatures he applied bleeding and oozing continued in considerable quantity. In those days there were no blood transfusions available and not even plasma or salt solution. Finally, however, he accomplished hemostasis without drainage. The patient remained alive and made an uneventful recovery.

DR. THOMAS W. McELIN (Closing).—I am appreciative of the courteous and instructive commentaries of the discussants. In answer to Dr. Funnell's question, there were no pudendal or local block anesthetics used in this series.



## MEGALOBLASTIC ANEMIA OF PREGNANCY

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**R**ECENTLY we have observed three patients with megaloblastic anemia of pregnancy. The disorder is rare in the United States, but more common in the British Isles, the source of most of the literature on the subject. There Davidson, Girdwood, and Clark<sup>1</sup> found 31 such cases in a series of 521 consecutive patients with microcytic anemias. Callender<sup>2</sup> reviewed the literature in 1944 and considered 255 cases to be acceptable as megaloblastic (primary) anemias of pregnancy, though in less than half of these was the diagnosis definitely proved. She has added 25 case reports.

The clinical and laboratory findings in this anemia are so characteristic, the treatment now so specific and curative, that we feel it worth while to review these features and report our cases. The correct diagnosis assumes greater importance in that adequate prophylaxis in subsequent pregnancies should prevent recurrence.

### Etiology

Various theories, none yet proved, have been advanced as to the cause of this condition. A history of dietary inadequacy frequently is obtained; however, obvious improper nutrition may date only from the onset of a sore mouth, a common feature which often develops some time before anemia is manifest. Apparently adequate nutrition has been maintained throughout pregnancy in many documented cases.<sup>2</sup> According to Angulo and Spies,<sup>3</sup> folic acid deficiency may exist in individuals who believe their diet to be adequate. Callender<sup>2</sup> has postulated that a bone-marrow-inhibiting influence, possibly of endocrine origin associated with pregnancy, may be responsible. Large amounts of follicular hormone given to dogs have produced anemia and thrombocytopenia. Dodds and associates<sup>4</sup> found that rabbits injected with Pituitrin developed lesions in the acid-secreting portion of the stomach, and in some of these animals a macrocytic anemia developed. Callender<sup>2</sup> theorized that the frequent gastric disturbance noted may be related to a pituitary influence, which may also reduce secretion of intrinsic factor.

### Clinical Features

Megaloblastic anemia may develop at any time during pregnancy, but is most common in the last trimester or in the puerperium. Rapidity of progression of the anemia is striking: precipitous fall in the erythrocyte count and hemoglobin may occur in a two-week period or less. Although symptoms

common to any marked anemia usually occur, complaints referable to the gastrointestinal tract may be outstanding: a sore tongue or other mouth lesions can be the first sign of illness or develop later in the course of the disease; vomiting and diarrhea occur in 40 to 50 per cent of cases.<sup>2</sup> The tongue often is quite red, and lingual papillary atrophy may be present. The skin becomes pale and waxy; retinal hemorrhages are frequent. Slight to massive edema, particularly of dependent parts, is common. The central nervous system is uninvolved. Fever, without evidence of infection, is a frequent finding: Stevenson<sup>5</sup> noted a febrile course in 17 of her 30 patients.

### Laboratory Studies

Peripheral blood studies reveal an anemia in which the erythrocytes are macrocytic and contain their full complement of hemoglobin. Anisocytosis and poikilocytosis are present, though these two aberrations occur to lesser degree than in true pernicious anemia. In 5 of Callender's 25 cases, a hypochromia of varying degrees was present. The leukocyte count shows no fixed pattern; both moderate leukocytosis and moderate leukopenia have been found. Large multinucleated polymorphonuclear cells are seen. The reticulocyte count is normal or low; serum bilirubin and urinary urobilinogen levels are generally normal, as are erythrocyte fragility studies.

Examination of bone marrow aspirate reveals megaloblasts in increased numbers; the myelocytic series is not remarkable, save for the feature noted above; megakaryocytes are present in normal or slightly reduced numbers. Gastric analysis demonstrates normal free hydrochloric acid content, though rarely histamine-fast achlorhydria has been reported.<sup>1</sup> One must be certain that true pernicious anemia does not exist, as the hazard of folic acid therapy alone in the latter is well known.

### Treatment

The response to liver extract given parenterally has been unpredictable.<sup>1, 6, 7, 8</sup> When an adequate response has occurred it may well have resulted from a sufficient folic acid content in the extract. Most of the literature indicates a relatively poor response to such therapy. Various investigators have observed patients refractory to parenteral liver injections who showed immediate response to liver taken orally.<sup>1, 6, 7, 8</sup> Vitamin B<sub>12</sub> is no more effective than liver extract.<sup>9, 10, 11</sup> Folic acid, on the other hand, has proved effective in all instances. When this substance is given in amounts of 10 to 20 mg. daily orally or by injection, marked reticulocyte response can be expected by the fifth day of treatment. Other manifestations of the disease gradually disappear as the blood count improves.

### Prognosis

There should be no fatalities with the means of treatment now available. Formerly it was felt that the disease did not recur; however, Callender has implied that recurrences of this anemia might be expected in two-thirds of

subsequent pregnancies. Folic acid taken prophylactically throughout pregnancy should prevent recurrence, though absolute evidence for this is yet to be presented.

The outlook for the fetus is good. The incidence of stillbirths or congenital abnormalities is not increased. Premature delivery, however, has been noteworthy: 8 of Stevenson's 30 patients, 6 of Callender's 25 cases, and 2 of our 3 patients delivered premature infants.

### Case Reports

CASE 1.—(St.J.H. No. 182432) M. H., a 33-year-old white woman, gravida iv, para iii, was admitted to the hospital on Dec. 5, 1951. She was Rh positive, Wassermann negative; her expected date of delivery was Dec. 27, 1951. The chief complaints were "swelling of my legs, sore tongue and mouth" of about five weeks' duration. On that day, a marked anemia had been detected by her physician. Her past history was quite unremarkable; she had had no difficulty during or following her three previous pregnancies. Her diet had always been adequate.

Five weeks prior to admission when she noted the above complaints, she consulted her physician. At this time a hemogram showed: hemoglobin 12.5 Gm., red blood cells 3.5 million, color index 1.22; leukocyte count 6,700 with 60 per cent polymorphonuclear neutrophils, 21 per cent young forms, 23 per cent lymphocytes, 5 per cent monocytes, and 1 per cent eosinophils. Macrocytosis, anisocytosis, and occasional polychromasia were noted. Erythrocyte sedimentation rate, corrected, was 53 mm. in one hour (Wintrobe method); urinalysis was not remarkable. Her physician prescribed a low-salt diet, multi-vitamin preparation, and bed rest. However, her symptoms progressed; both the lower extremities to the level of the iliac crests and including the vulva became edematous and she was hospitalized.

Physical examination on admission revealed: blood pressure 120/70, pulse 84, temperature 100° F., respirations 20. She was normally developed, appeared well nourished, and was not in acute distress. Her skin was pale and waxy; a herpes simplex lesion was on the upper lip, and a small superficial ulceration was beneath the tongue which was moderately reddened but showed no papillary atrophy. The lungs were normal; the heart was within normal limits. The abdomen contained a gravid uterus, the size corresponding to the length of gestation. A smooth, slightly tender liver was palpable 3 cm. below the right costal margin. No other masses were palpated. The extremities showed marked pitting edema extending to the iliac crests, overlying the sacrum, and involving the vulva. Neurological examination was normal.

*Laboratory Findings.*—The hemoglobin was 5 Gm., red blood cells 1.58 million, packed red cell volume 18 per cent; mean corpuscular hemoglobin 32 micromicrograms; mean corpuscular volume 112 cubic microns; mean corpuscular hemoglobin concentration 28 per cent. The leukocyte count was 8,200 with 84 per cent polymorphonuclear neutrophils, 13 per cent lymphocytes, 2 per cent eosinophils, and 1 per cent monocytes. Slight anisocytosis was noted. Urinalysis was not remarkable. Blood chemistry studies revealed: plasma protein 3.7 Gm. per cent with an albumin/globulin ratio of 2.4/1; urea nitrogen 18.5 mg. per cent, and uric acid 2.0 mg. per cent.

*Hospital Course.*—On the day of admission, Dec. 5, 1951, she was given 500 c.c. of whole blood. On the day following admission, sternal marrow showed megaloblasts present. A gastric analysis showed free hydrochloric acid. Thirty  $\mu$ g of vitamin B<sub>12</sub> was given intramuscularly each day. She was also given a repeat transfusion of 500 c.c. of blood. A reticulocyte count on this day was 1.9 per cent. On December 7, the membranes ruptured spontaneously and she delivered a vigorous 2,046 gram female infant without analgesia and with minimal nitrous oxide, oxygen, ether anesthesia. The newborn infant's hemoglobin was 19.7 Gm. per cent. Blood loss at the time of delivery was estimated at 50 c.c. Following delivery, the patient received 1,500 c.c. of whole blood over a period



of 48 hours. A blood count on the day of delivery showed hemoglobin 9.8 Gm., red blood cells 3.75 million, white blood cells 13,100, and reticulocyte count 1.2 per cent. The following day a count revealed hemoglobin 8.3 Gm. and 2.86 million red blood cells. On December 10, four days after vitamin B<sub>12</sub> was started and three days following delivery, the reticulocyte count was 3.4 per cent, hemoglobin 10.8 Gm., red blood cells 4.15 million, color index .9. On December 13, the reticulocyte count was 3.6 per cent, hematocrit 41 per cent, hemoglobin 12.0 Gm. per cent, and red blood cells 4.2 million, with a mean corpuscular hemoglobin of 26  $\mu$ g. The reticulocyte count on December 15 was 3.1 per cent. The patient was discharged from the hospital on Dec. 16, 1951, improved. During her hospital stay she had a daily spiking temperature until December 13 with no localizing signs or symptoms to explain the fever. However, she was given penicillin and streptomycin intramuscularly. At the time of discharge from the hospital, the edema had completely disappeared and her mouth was no longer painful. She was observed closely by her physician and, at last report, three months following delivery, her hemoglobin was 11.5 Gm., red blood cells 5.25 million, mean corpuscular hemoglobin 22 micromicrograms and reticulocyte count 0.8 per cent. During this time she had been taking an increased amount of cooked liver in her diet.

*Comment on Case 1.—*

This patient was treated with vitamin B<sub>12</sub> injections rather than folic acid because of lack of appreciation of the greater specificity of folic acid in this condition. The maximal reticulocyte response attained was 3.6 per cent on the eighth day of treatment. It is possible that there was some inhibition of reticulocytosis due to the blood transfusions; we believe, however, that there was an inadequate response to vitamin B<sub>12</sub>.

CASE 2.—(C.G.H. No. 37566) V. H., a 28-year-old white, married gravida ii, para i, whose expected date of confinement was May 14, 1952, gave no history of bleeding tendencies, anemia, or blood dyscrasias in the family. The patient had had anterior poliomyelitis at the age of 3 with no sequelae. Her previous pregnancy was uncomplicated.

She was first seen in the outpatient clinic on Nov. 19, 1951, in the fifteenth week of pregnancy without complaints. Physical examination was essentially normal. Urinalysis was normal; hemoglobin 9.0 Gm. per cent, red blood cells 3.4 million, white blood cells 8,900, with a normal differential. Serologic tests were negative and she was Rh positive. Chest x-ray was normal.

The patient's prenatal course continued to be uneventful and she was again seen in the prenatal clinic on Feb. 7, 1952, the twenty-fifth week of gestation. At her next visit, repeat blood counts revealed a hemoglobin of 7.8 Gm. per cent, red blood cells 2.0 million, hematocrit of 27 per cent, mean corpuscular hemoglobin 39 micromicrograms, mean corpuscular volume 135 cubic microns, mean corpuscular hemoglobin concentration 29 per cent, and a reticulocyte count of 0.6 per cent. She complained of soreness of the tongue, shortness of breath, moderate weakness, fatigability, and she noted a pallor of the skin. Bone marrow studies done at this time revealed a marked megaloblastic reaction. Gastric analysis showed free acid in 30 minutes after an alcohol meal. Neurological examination was normal. On March 27, 1952, folic acid, 10 mg. by mouth daily, was instituted. Within a few days she had marked relief from the glossitis and on April 4, 1952, she was completely asymptomatic. She had been taking maintenance doses of folic acid as described above. On April 4, 1952, the hemoglobin was 8.5 Gm., red blood cells 2.5 million, and reticulocyte count 16.0 per cent. On April 21, 1952, the patient was admitted to the hospital in active premature labor. The hemoglobin was 8 Gm. per cent. She was transfused during labor with 500 c.c. whole blood. She was delivered spontaneously on April 21, of a viable 2,670 gram male infant under pudendal block anesthesia. The estimated blood loss after delivery was 300 c.c. A hemoglobin determination six hours after delivery was 10 Gm. per cent, and the patient received another 500 c.c. of whole blood. On April 22, 1952, the hemoglobin was 14 Gm. per cent, red blood cells 4.5 million, with no reticulocyte count



recorded. The patient received no folic acid during her hospital course, which was completely uneventful and both the patient and infant were discharged in good condition on April 25, 1952.

On May 12, 1952, three weeks post partum, the patient was seen in the clinic at which time she was completely well. Hemoglobin was 13.5 Gm. per cent, red blood cells 4.2 million, reticulocyte count 0.6 per cent, white blood cells 6,500 with a normal differential, hematocrit 42 per cent, mean corpuscular hemoglobin 32 micromicrograms, mean corpuscular volume 100 cubic microns, and mean corpuscular hemoglobin concentration 32 per cent.

*Comment on Case 2.—*

This patient demonstrated the usual reticulocyte response and remission of symptoms afforded by adequate folic acid therapy.

CASE 3.—(C.G.H. No. 49038) M. R., a 30-year-old Negro woman, was gravida iii, para ii, Rh positive, and Wassermann negative. She was seen for the first time on Oct. 28, 1952, in the thirty-sixth week of pregnancy, complaining of mild dyspnea, weakness, and palpitation. Her past history revealed two normal pregnancies. In September, 1951, at another hospital, she had had a subtotal gastrectomy and a gastrojejunostomy for peptic ulcer. She had no anemia at that time. A gastric analysis had not been performed. Physical examination at this time revealed an intrauterine pregnancy of stated gestational age and a clinically obvious anemia. Otherwise, physical examination was negative.

Laboratory studies were as follows: hemoglobin 6.0 Gm. per cent, red blood cells 2.4 million, hematocrit 27 per cent, mean corpuscular hemoglobin 27 micromicrograms, mean corpuscular volume 112 cubic microns, mean corpuscular hemoglobin concentration 24 per cent, reticulocytes 2.4 per cent; bone marrow aspiration studies revealed a megaloblastic marrow. No free hydrochloric acid was found in the stomach contents after histamine. Stool examinations for occult blood were negative.

Because of the severe anemia and the proximity to term, she was transfused and given folic acid, 15 mg. daily, and iron. Ten days after starting the therapy, the reticulocyte count was 7.6 per cent.

In the thirty-ninth week of pregnancy on Nov. 13, 1952, she was readmitted in active labor and delivered spontaneously a 2,080 gram female infant. The blood loss was minimal at the time of delivery. However, because the hemoglobin was 8.5 Gm. per cent, she was given 500 c.c. of whole blood post partum.

One week after delivery, she was readmitted after a normal hospital course of five days with a late postpartum hemorrhage due to retained secundines. She received 1,500 c.c. of whole blood to combat the shock. A dilatation of the cervix and curettage of the uterus was done. A blood examination at the time of discharge showed 11 Gm. per cent of hemoglobin and 3.6 million red blood cells.

The last time this patient was seen was Dec. 12, 1952, one month post partum, at which time the hemoglobin was 9.5 Gm. per cent, and red blood cells 3.5 million. She had been taking folic acid and iron since the thirty-eighth week of pregnancy.

*Comment on Case 3.—*

The diagnosis of megaloblastic anemia of pregnancy is quite probable in this instance.

Pernicious anemia, which would be suggested by the histamine-fast achlorhydria, occurs uncommonly in Negroes and is rare in a person of this age.<sup>12</sup> Wintrobe<sup>13</sup> states that, following gastric resection, complete or partial, and after gastroenterostomy, a hypochromic microcytic anemia rather than macrocytic anemia may develop. In several large series totaling 930 cases of partial gastrectomy and gastroenterostomy, only one case of macrocytic anemia was found.<sup>14</sup> Members<sup>15, 16</sup> of the gastroenterology and hematology divisions at this center believe it highly unlikely that a megaloblastic anemia would develop in a thirteen month period as a result of an operative procedure on the stomach.

### Discussion

Three patients with megaloblastic (primary) anemia of pregnancy have been encountered during the past two years. The clinical and laboratory features of this disease have been reviewed in conjunction with the case reports. Whenever anemia is demonstrated during pregnancy and fails to respond to iron replacement therapy, primary anemia of pregnancy should be suspected. If anemia, glossitis, or edema develops suddenly, or persists during pregnancy, primary anemia should be considered. The diagnosis is readily established by the demonstration of increased megaloblasts in the sternal bone marrow. Peripheral blood studies will reveal macrocytosis of the red blood cells. The treatment is specific and successful, and consists of the oral administration of 10 to 20 mg. of folic acid daily. The folic acid may be administered by intramuscular injection but the oral preparation is just as effective.

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## OBSTETRICAL HYPNOANALGESIA

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SINCE the days of the American Revolution and Austria's Franz Anton Mesmer, hypnosis, in one form or another, has been used to allay the discomforts of childbirth and there is evidence that it was practiced in primitive cultures; yet even today certain circles, both lay and medical, cast a critical and jaundiced eye on this stepchild of medicine, associating it with witchcraft, mysticism, and darkened rooms. It is difficult to understand why many physicians consider hypnotism and charlatanism as synonyms while constantly employing suggestion in their daily practice. Newspapers sensationalize the subject and as recently as 1948 a United Press dispatch<sup>48</sup> on Johns Hopkins Hospital's first birth under hypnosis was featured on the front page of many leading newspapers. Schmedhofer<sup>40</sup> has even gone so far as to substitute the term *therapeutic relaxation* to avoid the stigma of the word *hypnosis*. Yet, in this chaos of misunderstanding and prejudice, many noted obstetricians<sup>1, 6, 7, 12, 20, 21, 22, 23, 26, 27, 28, 31, 32, 47</sup> have been quietly working in the field, pausing occasionally to present well-controlled series of cases in which hypnotic analgesia has been employed.

The widely held concept that primitive women, not being neurotic, did not suffer and bore their children with no discomfort is without foundation. Pain is not a product of our civilization, although suggestion does play an important role. From studies based upon questions asked women of contemporary primitive societies, Devereux<sup>8</sup> discovered that "... speculations about primitive childbirth tend to distort reality to a rather considerable extent. Even sketchy anthropological studies usually list rituals and taboos believed to facilitate childbirth, protect mother and child, and overcome various difficulties connected with labor." Hrdlicka<sup>17</sup> mentioned in a United States government ethnological report that Mohave Indian women experienced considerable discomfort, but were quiet about it in order to avoid ridicule. Thus, we see *apparent* freedom from pain as a cultural response rather than an actuality. Grantly Dick Read,<sup>36</sup> a leading exponent of natural childbirth, concedes that his method of "education, relaxation, and suggestion" is "physically comfortable, that is, there is no *unbearable* pain." His technique is directed toward using *less* analgesia and anesthesia. Thoms<sup>45, 46</sup> has corroborated the Read technique, yet rather vehemently denies that this modification of Read's method has the attached stigma of hypnosis. Throughout his monograph, however, there is considerable evidence of both direct and indirect suggestion. His denial of mode is in direct opposition to Read's affirmation<sup>35</sup> that "... the more strongly one appreciates the truth of a technique and the more confidence one has in the success of it ... so much the more your patient has the feeling of confidence which is so essential to carry her through labours,

and to enable her, during labour, to conduct herself as she has been instructed to do." Kroger<sup>19</sup> has expanded this idea further when he states that "when- ever Read enters the labor room, the *suggestion* of success is so strong, without a doubt, all his patients lose all their fears and are able to carry out the treatment they had during antenatal preparation."

Occasionally we see in the literature statements suggesting that so-called natural childbirth accomplishes no measurable diminution of the actual intensity of labor pain nor is it the "drugless method glorified in lay publications."<sup>5</sup> In many ways this is true, the deciding factor being the degree of suggestion employed by the obstetrician managing the case. This variable factor may be obviated by using hypnoanalgesia per se. Certainly a method that has proved itself in major surgery,<sup>3, 4, 10, 11, 14</sup> minor surgery,<sup>3, 11, 14, 37</sup> and the control of intractable pain due to chronic disease<sup>9, 18, 38</sup> can lend itself to the discomforts of parturition.

In one of the earlier controlled investigations done on the use of hypnosis in obstetrics in 1922, Schultze-Rhonhof<sup>43</sup> achieved a success of 89.5 per cent in 76 cases. He notes that the disadvantages are only those of time and the availability of qualified hypnotists, further stating that these difficulties may be quite easily overcome. Five years later, Kalashnick<sup>18</sup> presented a series of cases in which hypnosis was used successfully to eliminate apprehension prenatally and used instead of anesthesia during delivery. Throughout the literature one sees repeated apologies for the time consumed in the antenatal preparation, yet when one considers the numerous advantages offered by hypnoanalgesia, it is easy to see that howsoever time consuming it may be, the disadvantages are outweighed. Physicians should remember that repeated suggestions, with or without the aid of medication, can accomplish a great deal in labor, particularly for the relief of fear as well as for the pains of labor. In reviewing the work of Abramson,<sup>1</sup> Angulo,<sup>2</sup> DeLee,<sup>6, 7</sup> Hardy,<sup>13</sup> Heron,<sup>14</sup> Kalashnick,<sup>18</sup> Kroger and Freed,<sup>20, 21, 22, 23</sup> Magonet,<sup>25</sup> Newbold,<sup>26, 27, 28</sup> Owen-Flood,<sup>29</sup> Pattie,<sup>30</sup> Raginski,<sup>34</sup> and Schneck,<sup>41</sup> the following points in favor of obstetrical hypnoanalgesia were emphasized, namely: ease of administration and the fact that once deep hypnosis with anesthesia has been suggested and obtained, it can be immediately reinduced with any sensory distribution desired; elimination of apprehension and discomfort prenatally; a method of controlling emesis and hyperemesis gravidarum; elimination of the inherent dangers of chemical anesthetics; induction of labor and average reduction of two hours in the first stage of labor; immediate removal of anesthetics when desired; perineal relaxation with decreased tendency toward tearing; prevention of intrauterine fetal anoxia, utilizing an analgesic suitable for perineal repair; increased resistance to obstetrical shock and decreased blood loss; elimination of postpartum discomfort; and an indirect galactagogue since it decreases anxiety. From the foregoing, one should not conclude that obstetrical hypnoanalgesia is infallible. Along with the disadvantages of prejudice and inertia comes the real danger of precipitating a psychosis in a pre-



psychotic individual. However, it should be emphasized that it is probable that the psychosis might well be brought forth by pregnancy per se. Thus we see a problem, primarily of medicolegal import.

In general the best subjects are those of above average intelligence,<sup>34</sup> while those of lesser endowment are more difficult and less satisfactory to work with. Unfortunately, I. Q. is no index of fertility. However, when a mixed, random group is considered, only 5 per cent or less are entirely uninfluenced while 25 per cent will pass into a somnambulistic trance. The remaining 70 per cent are influenced to a degree that will usually prove adequate for hypnoanalgesia of a suitable depth for delivery.<sup>49</sup> These percentages are considerably elevated with narcosynthesis<sup>16, 23, 26</sup> or prolonged training. At first glance, the latter method would seem unsuitable because of the time-consuming factor, but this feature can be largely eliminated by training groups of women on a ward service basis. Wolberg<sup>51</sup> believes that, if attempts at induction of trance are carried out for a long period of time, all persons, save mental defectives, will ultimately respond favorably to hypnotic suggestion.

With particularly receptive or extremely fatigued patients, hypnotic trance may be induced in the labor room, but this is generally inadvisable since percentages of success are greatly reduced without prior training and when severe pain exists unless one resorts to narcohypnosis.<sup>23, 24, 27</sup>

It would thus seem entirely logical to carry *natural childbirth* one step further with the induction of a trance state and thus improve our results. Being a purist is not essential. It is not even advisable. Too few leaders in the field of chemical anesthesiology, exponents of natural childbirth, or exhorters of hypnoanalgesia admit the advantages of each, using any or all in combination. Actually, narcosynthesis combines all three and is of definite advantage, working beautifully in almost all cases though necessary in only about 20 per cent of the cases<sup>31</sup> if an adequate amount of time is spent with each patient prenatally. Making up your mind and sticking to it is not a virtue in medicine, and the obstetrician should reserve the privilege of adding chemical anesthesia should natural childbirth or hypnoanalgesia prove unsatisfactory in *any* respect. Good obstetric practice should concern itself more with the preparation of the woman's mind and less with the administration of noxious drugs, lessening the need of the latter by adequate prenatal preparation.

The problem of obtaining qualified hypnotists is real but not insurmountable. Any physician can quite easily become proficient in the field merely by careful study of the literature and subsequently developing a sense of professional adequacy upon obtaining good results with selected patients. Schneck<sup>42</sup> has published a reading list for professional instruction that is a good starting point but a more practical reading source for obstetrical hypnoanalgesic techniques may be found in the recent writings of Kroger and/or Freed.<sup>20-23</sup> One need not subscribe to the method wholeheartedly, but certainly one can follow the principles of suggestive therapeutics in the management of pregnancy and labor. A useful tool should not be discarded from the practitioners' armamentarium because it is derived from a misunderstood branch of medicine.

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## PRIMARY CANCER OF THE VAGINA\*

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**P**PRIMARY cancer of the vagina has been looked upon in the past as a rare disease with a very poor prognosis.

The lesion was first described as an entity by Cruveilhier in 1826 before the Anatomical Society of Paris and since then there have been a large number of reports on isolated or unusual cases but comparatively few reports of large series of cases, particularly from the gynecologic and therapeutic aspects. As recently as 1935, Taussig,<sup>1</sup> in speaking to the American College of Surgeons, stated: "Primary carcinoma of the vagina is very rare and almost universally fatal. We acknowledge our total inability to do anything effective for primary cancer of the vagina." DeBüben<sup>2</sup> called the lesion "the most malignant and most difficult to cure of all gynecological cancer."

The fact that this cancer is infrequent prevents any individual, group, or clinic, with a few exceptions, from seeing many cases, and its comparative rarity probably in part accounts for the gloomy prognosis, since few can become proficient in its therapy.

Recently, there have been several excellent reports published and these, coupled with the recent improvements in radiotherapy and surgical techniques, should help to enlighten us concerning the natural history of the disease and aid in increasing our survival rates.

### Basic Considerations

Primary vaginal cancer must be differentiated from the much more common secondary cancer of the vagina. These secondary vaginal cancers (direct extensions or metastases) are most common from carcinoma of the cervix, less common from fundal carcinoma (either adenocarcinoma or chorionepithelioma), and still less frequent from ovarian cancer, hypernephroma, etc.

Taussig<sup>3</sup> explains the two manners in which secondary tumors arise in the vagina, either by superficial implants from higher up in the genital tract or by venous or lymphatic transport. While vaginal metastases from the cervix to the vagina may be localized anywhere in the vagina through lymphatic drainage or implants, the other tumors mentioned, whose circulation is related to the ovarian vessels, frequently show their metastases only in the suburethral area.

In order to understand the spread of vaginal cancer we must comprehend the basic lymphatic drainage of the vagina. This was best described by

\*Read before the Department of Obstetrics and Gynecology of the Buffalo General Hospital on April 8, 1953.

Rouvière.<sup>4</sup> The lymphatics from the upper half of the vagina drain to the interiliac nodes and to the internal iliac nodes and generally follow the cervical lymphatics. Those of the lower end drain to the inguinal nodes but some go directly to the external iliac nodes. There is free anastomosis between the upper and lower halves and the right and left sides. In considering the lymphatic spread of the tumor, the vagina is considered in thirds. Those tumors of the upper third act similarly to carcinoma of the cervix; those of the lower third act like carcinoma of the vulva, and those of the middle third drain by either route.

### Material and Methods

The material in this review includes all patients with primary cancer of the vagina seen at Roswell Park Memorial Institute from January, 1919, to December, 1952, a period of 33 years. These patients were all referred to the Institute by their own physicians for treatment or for diagnosis and treatment if diagnosis had not been previously established.

The records were carefully examined in each case for evidence of proof of the diagnosis. Several records were discarded as not satisfying our rather stringent criteria, which were based on those set up by the Radiological Subcommittee of the Committee on Hygiene of the League of Nations as modified in 1932.<sup>5</sup> There were: (1) site of growth in the vagina; (2) clinical examination showing the cervix to be intact; (3) no ground for supposing it to be other than a primary growth in the vagina.

In addition to the above, the following modifications were added:

1. All our patients had the pathological diagnostic material reviewed by our Pathology Department. No written report of other pathology laboratories was accepted as evidence.

2. Any case which showed involvement of the cervix by the extension of the tumor onto the portio of the cervix but not involving the mucosquamous junction was allowed but if the tumor involved the external os of the cervix or appeared to originate at the edge of a cervical erosion it was disallowed. This was based on the commonly accepted dictum that nearly all cancer of the cervix originates at the squamocolumnar junction of the cervix.

3. Many patients had biopsies of both the cervix and the vaginal lesion in which the former were negative and the latter positive for tumor.

4. If the urethra, bladder, or rectum was involved by tumor, procedures such as cystoscopy or proctoscopy were performed to exclude primary tumors of these organs.

5. In the few situations where the whole vaginal tube was filled with tumor and the cervix could not be demonstrated, they were counted as primary vaginal cancer if there was no direct involvement clinically beyond the paravaginal tissues. The differentiation of primary from secondary involvement was at times most difficult to determine and when doubtful such cases were excluded from this study.

6. There were some cases previously diagnosed as primary adenocarcinoma of the vagina but here the evidence was so tenuous for a primary vaginal origin that they were not included.

The resulting group of 112 cases is made up of those which we feel to be proved primary vaginal cancer and the results of the study are thus not invalidated by the inclusion of questionable or presumptive material.

Once a patient has a diagnosis of cancer made, she is never discharged from the clinic but continues to return for periodic examinations at intervals



no longer than 12 months until either she is lost or death ensues. As a result of the excellent system of follow-up conducted in conjunction with the Records Department, it is rare that a patient is lost.

TABLE I. TOTAL CASES OF PRIMARY GYNECOLOGICAL CANCER AT ROSWELL PARK MEMORIAL INSTITUTE, 1919-1952

CANCER OF	NUMBER OF CASES	RATIO	PERCENTAGE
Cervix uteri	5,500*	55	66.2
Fundus uteri	1,400*	14	16.9
Ovary	900*	9	10.8
Vulva	400*	4	4.8
Vagina	112	1	1.3

\*Approximate.

### Incidence

The distribution of the gynecological malignancies at the Roswell Park Memorial Institute is given in Table I. This shows that vaginal cancer constitutes 1.3 per cent of the total, a figure not at variance with the results reported by other authors whose values range from 0.11 per cent to 2.7 per cent, the majority showing over 1 per cent.<sup>1, 2, 6-14</sup>

Messelt,<sup>12</sup> utilizing the fact that practically all women over 25 with primary vaginal cancer in Norway have their therapy at the Norwegian Radium Hospital, calculates the incidence in the population there at one case of primary vaginal cancer to 160,000 women over age 25.

TABLE II. NUMBER OF PATIENTS AND PERCENTAGE IN TEN-YEAR AGE GROUPS AT ROSWELL PARK MEMORIAL INSTITUTE

YEAR GROUP	NUMBER OF PATIENTS	PERCENTAGE
Age 10-19	0	0
20-29	4	3.6%
30-39	5	4.4%
40-49	20	18.0%
50-59	29	26.0%
60-69	36	32.0%
70-79	15	13.4%
80-89	3	2.6%
Average age, 57.5 years		

### Age.—

The age distribution of our patients with primary vaginal cancer is shown in Table II with an average age of 57.5 years.

It appears that the age groups of these patients approximate those of patients with cancer of the vulva and the corpus rather than of the cervix.

There is a good deal of difference in the ages of these patients as noted by various authors. Novak<sup>15</sup> feels the most common age to be 35 to 55, while Ewing<sup>16</sup> believed it most common between 30 to 40. On the other hand, Hurdon<sup>17</sup> found only 2 of her 23 patients under 50 years with 74 per cent of the group over age 60. Most reports, however, show average ages from 46.7 to 56.0 years.<sup>6, 9, 11, 13, 14, 18</sup>

The occurrence of the disease under the age of 20 is exceedingly rare. We have found only ten such reported cases.<sup>19, 20, 21</sup> None of our patients fell in this category.

*Race and Religion.—*

No Negro women were found among the patients in this study. On the other hand, other clinics have reported an occasional case in a Negro. Livingstone in his Memorial series found a 10 per cent incidence in Negro women and Higginson recently reported a number of vaginal cancers in Bantu women. The fact that we have no Negro women with vaginal cancer is surprising in view of the Negro population of the area from which our patients are drawn and in view of the fact that the other services of the Institute have an appreciable number of Negroes.

From the information available on our patients' records, none were Jewish. Kaiser<sup>22</sup> points out that the one Jewish patient in his group appears to be the only one of her religious group so far reported with primary vaginal cancer. This would be in keeping with the oft reported low incidence of cervical carcinoma for Jewish women.

*Family History.—*

Only 4 of the 112 patients gave a history of cancer in parents or siblings, i.e., 3.6 per cent, and only one of these familial cancers was genital. Other authors, however, report higher percentages of familial cancers.<sup>13, 14</sup>

*Menstrual Histories.—*

The menstrual data showed no significant change from the accepted normals. Twenty-four patients, or 21.4 per cent, were premenopausal at the time of the diagnosis of the disease. Fourteen patients, or 12.5 per cent, had had a radiotherapeutic or surgical menopause, and 74 patients, or 66 per cent, had had a natural menopause at the time of diagnosis.

The average age of climacteric for the whole group of postmenopausal women was 46.1 years and for the group with the normal menopause alone it was 47.2 years.

The induced climacteric was the result of surgical procedures in twelve patients: 5 subtotal hysterectomies, 4 total hysterectomies, and 3 bilateral ovarian excisions. There were 2 patients who had had radium previously (see below).

Livingstone states that 55.6 per cent of his group had a spontaneous menopause at an average age of 48.4 years, and 7.4 per cent had ovarian cessation as a result of previous unrelated surgery.

*Parity.—*

The average number of full-term children for the group of patients was 2.7. Thirty-two patients, 28.4 per cent, were nulliparous; 50 patients, 44.6 per cent, were para i to iii, and 31 patients, 25.5 per cent, were para iv to xii.

Of the 32 nulliparas, 4 patients were unmarried, 3.5 per cent, and 28 patients, 25.0 per cent, were married. Of the latter group, one patient had had an ectopic gestation and one had had early castrating surgery. Other authors report similar values for nulliparous patients with vaginal cancers.<sup>10, 11, 12, 13, 18</sup> Comparison with previous reports from the Institute on fundal and cervical cancer showed 3.8 per cent of patients with cervix cancer and 11.9 per cent of patients with fundus cancer were unmarried while 16.2 per cent and 24.1 per cent, respectively, were married nulliparas.

*Previous Gynecological Diseases.—*

Twenty of our patients had had previous gynecological disease completely unrelated to the vaginal carcinoma. Eight patients had had subtotal hysterectomies of which 4 were for fibroids at intervals of 21, 11, 8, and 5 years before diagnosis of vaginal cancer; one had had the operation 23 years previously for an unknown reason, and 2 others were operated on 7 and 2 years before diagnosis of vaginal cancer with no malignancy being noted in the operative specimen.

Four patients had had total hysterectomies, of which 2 were done for fibroid uteri 9 and 5 years before diagnosis of cancer, and the other 2 were performed for dysfunctional bleeding 8 and 7 years previous to diagnosis of cancer.

Four patients had had unilateral oophorectomy for various benign lesions at intervals of 37, 29, 13, and 10 years before diagnosis of vaginal cancer and 3 women had had bilateral oophorectomy with no clear indications for the surgery 39, 20, and 4 years before the vaginal cancer.

One patient had had a hydatid mole 17 years previously, one patient had had a carcinoma of the cervix, Stage I, treated 21 years previously with no recurrence, and there was another possible carcinoma of the cervix without a positive biopsy report, treated with radium 18 years before the onset of vaginal cancer.

Four patients, 3.6 per cent, had had third-degree prolapse of the uterus for periods of 25, 15, 8, and 2 years, respectively. Third-degree prolapse is shown by most writers to be present in 2 to 4 per cent of patients with vaginal cancer and is not thought to be significant as an etiological factor unless complicated by pessaries.

*Associated General Diseases.—*

Syphilis was found in only 6 patients, 5.3 per cent, and in none since 1942. Levin and Kress<sup>23</sup> have shown that syphilis is no more common in women with vaginal cancer than in any otherwise normal group of white women. The same authors report syphilis to be present three times more frequently in patients with cervical cancer than in the normal female population. Thus, despite the fact that syphilis has a predilection for the squamous epithelium of the genital tissues, it does not appear to be an etiological factor in vaginal cancer.

Diabetes was reported in three patients, 2.7 per cent. On the basis of large surveys<sup>24</sup> it has been reported that 1.02 per cent of women over 35 years of age have diabetes, a figure not significantly different from ours. Our 2.7 per cent diabetes rate is to be compared with 16.9 per cent diabetic women with fundus carcinoma in our clinic.

Hypertension was seen in 11 of the 30 cases in which the blood pressure was reported, 36.6 per cent of the 30 patients. Masters and Marks<sup>25</sup> report that 40 per cent of women between 40 and 49 have hypertension and the figure climbs to 80 per cent for 70 years plus. Thus our figure is not significantly different from the reported normals.

### Possible Etiological Factors

The lack of definite inciting factors in vaginal cancer is fairly obvious but many possible contributing factors have been suggested: pessaries, coitus, prolapse of the uterus, trauma of childbirth, douches, vaginal discharge, estrogens, leukoplakia, masturbation, chemicals, etc.

DeBüben felt that leukoplakia of the vagina was a possible precursor. Our records do not lend themselves to such a study. Stacy and Moench claimed that leukorrhea was an important antecedent symptom in 42.9 per cent of their groups.

In 4 of our patients, pessaries were a possible etiological factor. These patients had worn ring pessaries almost continuously for periods of 32, 17, 11, and 9 years. Three of these patients had advanced cancer and died within the first year. One patient definitely developed vaginal carcinoma at the point of pessary contact with the vaginal wall and is alive without evidence of disease after three years.

Many authors have had patients in whom the chronic irritation of a pessary was associated with vaginal cancer. Way<sup>11</sup> believes that there is an increased incidence of vaginal cancer in women with prolapsed uteri, particularly if they have worn pessaries. Corseaden<sup>27</sup> states that although a pessary may be a common irritant there is no proof that it directly produces cancer.

Several authors have considered the question of the possible carcinogenic effect of high levels of estrogen on the vaginal mucous membrane. However, there have been only a few experimental studies in this field such as those of Geist and Salmon.<sup>28</sup> These authors experimentally produced vaginal cancer in rodents by prolonged continuous high dosages of estrogen. They state, however, that it is impossible to compare such experimentally produced cancers in rodents with the clinical occurrence in human beings and it appears to them that there is no evidence to justify the fear that carcinoma of the genital tract may result from the therapeutic use of estrogens.

Only 3 patients of our group had been receiving any significant amount of estrogens either by pills or injections before or during the present illness. In none could the estrogen therapy be considered a definite etiological factor since it was administered after the onset of symptoms. These patients, however, as a result of estrogen treatment, showed delay in diagnosis of 7, 9, and 13 months for which the doctors were directly responsible.

#### *Associated With Pregnancy.—*

To investigate further the question of estrogens as a possible etiological factor we must think of the relation of vaginal cancer to that physiological state in which the estrogen levels of the body are normally high, that is, pregnancy.

We had only 3 patients in whom the disease was associated with pregnancy.

The first was a 41-year-old woman who had been delivered by cesarean section for primary obstetrical reasons twenty months before she was first seen



in clinic, but who had symptoms of bloody discharge and dyspareunia since delivery. Her lesion was treated with radium only and she has now been alive and free of disease 18 years.

The second was a 23-year-old woman whose diagnosis was first made during a routine pelvic examination in early pregnancy and who was completely asymptomatic at that time from the disease. She was treated by interstitial radium needles, went on to abort the fetus, and has been free of disease now for 11 years.

The third was a 30-year-old woman who first went to her physician complaining of three months' amenorrhea. She was found to be pregnant and at the time of the original examination a 2 by 2 cm. carcinoma of the upper posterior vaginal wall was noted. She was treated with radium seeds only and the lesion completely resolved. The patient went on to deliver a normal full-term fetus per vaginam and since then has continued to menstruate regularly and has been free of disease now for twenty years.

Approximately a dozen patients have been reported in the literature to date with vaginal cancer associated with pregnancy and as far as can be determined all of these patients died either during pregnancy, during the immediate puerperium, or shortly post partum. Several of them, including Tuft's, Barnes',<sup>8</sup> and Mengert's<sup>30</sup> patients, were delivered by cesarean section. From our material it would appear that pregnancy is not quite the poor prognostic association it has been reported.

There is little direct evidence that pregnancy is an etiological factor per se or that the level of estrogenic hormone at this time or for that matter at any age or status is significant as a factor in the production of vaginal cancer. On the other hand, many agree with DeBüben that vaginal cancer grows more rapidly during pregnancy. This perhaps might be expected as a result of the concomitant increase in pelvic vascularity in this state but has not been proved.

#### *Weight.—*

The average weight of the 95 patients whose weight was reported on admission was 146 pounds, the lightest 90 pounds and the heaviest 270 pounds. Fifty-eight of our patients reported a weight loss in the six months previous to diagnosis averaging 14.5 pounds and ranging up to 60 pounds. Thirty-seven women reported no weight change and in 17 cases there was no report of a weight loss.

If full consideration is given to the average 14.5 pounds weight loss that over half the women experienced, the average of 146 pounds would then be greater. This corrected weight would possibly tend to put these patients in the same obese class in which fundal carcinoma is more frequently found.

#### **Symptoms**

In most respects, the disease expresses itself in a manner not unlike a malignancy of the cervix. The early lesion is asymptomatic. Painless bleeding is noted as the most frequent and often the first symptom complained of in 75 to 85 per cent of patients in previous reports.

TABLE III. SYMPTOMS ASSOCIATED WITH THE VAGINAL CANCER

SYMPTOMS	NUMBER OF COMPLAINTS	PERCENTAGE
1. Bleeding	75 (spotting 66, flow 9)	67
2. Discharge	19	17
3. Lower abdominal discomfort	17	16
4. Frequency and dysuria	10	9
5. No symptoms	10	9
6. Backache	8	6.6
7. Mass in vagina	5	4.5
8. Menorrhagia	4	3.5
9. Leg pain	4	3.5
10. Vulvar or vaginal soreness or pruritus	4	3.5
11. Dyspareunia	3	2.7
12. Rectal pain	3	2.7
13. Metrorrhagia	2	1.8
14. Contact bleeding	2	1.8
15. Miscellaneous		
Rectal bleeding	1	
Rectal mass and constipation	1	
Urinary obstruction	1	
Pain in the right foot	1	3.5
Total	170	

TABLE IV. SUMMARY OF PRIMARY COMPLAINT ON INITIAL MEDICAL CONSULTATION

SYMPTOM	NUMBER OF PATIENTS	PERCENTAGE
1. Bleeding (all forms)	65	58
2. Pain (all forms)	22	20
3. No symptoms	10	9
4. Discharge (all forms)	9	8
5. Urinary symptoms	4	3.5
6. Vaginal mass	3	1.5
Total		100.0

Table III expresses the number and percentage of all the symptoms complained of by outpatients. This shows bleeding of all kinds alone or in combination with other symptoms in 75 per cent. Again it should be noted that in most of these women this bleeding is postmenopausal. Vaginal discharge of all kinds was noted in 17 per cent of the patients, urinary disturbances in 10 per cent, and pain of all kinds in 37.5 per cent. The latter, however, is characteristically a late symptom and indicates connective-tissue involvement. As the lesion grows and extends into the rectum or bladder or involves bone, we may have symptoms of tenesmus, constipation, disturbances of urination, and bone pain. Fistulas appear in a late stage, of course, and in the terminal stages anorexia, anemia, and cachexia supervene. It should be pointed out that fully 9 per cent of our patients were nonsymptomatic.

Table IV shows the primary complaints which took the patient to the doctor. Although vaginal bleeding was present in 75 per cent of the total group it was the symptom which sent her to the physician in only 58 per cent. It appears that pain was much more impressive than bleeding in prompting medical consultation. Vaginal discharge, urinary disturbances, and the presence of a vaginal mass comprised together just 13 per cent and if the asymptomatic group is put aside it appears that 78 per cent of the patients came to the doctor complaining of either bleeding or pain.

*Duration of Symptoms.—*

The postmenopausal patients showed an average of 11.4 years between the age at the menopause and the time of cancer diagnosis. Livingstone found a 12.7 year interval.

TABLE V. DURATION OF SYMPTOMS

NUMBER OF MONTHS	NUMBER OF PATIENTS*	PERCENTAGE
Asymptomatic	10	9.0
One month or less	18	16.3
One month to six months	50	45.4
Six months to twelve months	24	21.9
Twenty-four months	4	3.7
Thirty-six months	4	3.7
Average length of symptoms for 100 patients, 7.3 months		
Total	110	100.0

\*Two patients had no record of length of symptoms.

In Table V the duration of symptoms is presented. The walls of the vagina present a thin, unresisting barrier to spread of neoplasm and the inevitable erosion of the network of blood vessels assures early onset of symptoms. We note in Table V, 10 asymptomatic patients. These include 3 who were examined for symptoms of prolapse of the uterus and carcinoma was found during the pelvic examination; 3 whose lesions were discovered during routine periodic pelvic examinations; 2 whose cancers were found during pregnancy on routine pregnancy examinations, and 2 whose cancers were picked up on routine Papanicolaou smears when no obvious lesions could be seen on first examination. The average length of symptoms for the remaining 100 patients was 7.3 months.

Cytologic studies were performed in only a few patients in our series, not so much because the test is comparatively recent but that most tumors are obvious and far advanced when first seen and present no diagnostic problem. Cytologic studies did, however, point up some significant facts in the cases where they were done. The 2 patients who had positive routine Papanicolaou smears done by their own doctors had no tumor recognized by these physicians and the tumors were found only on later investigation here. Six patients of our cancer group had smears done in our clinic and all but one were reported positive. It would be expected that cytologic samples of the posterior fornix pool would produce a higher percentage of positive results in early cases of vaginal cancer than the direct cervical or vaginal smears taken with the Ayre spatula or other methods. The smear is, however, invaluable as an aid in the follow-up on these patients for residual or recurrent tumor.

*Patient Delay.—*

The data on our patients were amenable to a patient- and doctor-delay study. Patient delay indicates a period of more than one month between the onset of symptoms and medical consultation. The length of delay for the patient is shown in Table VI. Sixty-six patients, 59 per cent, experienced a delay which averaged 8.6 months for the 66 patients, and 5.0 months for the whole 112 patients.

Of the 66 patients who delayed, 41 per cent delayed up to four months, in 23 per cent the delay was up to seven months, and in 23 per cent the delay was up to one year. Fourteen per cent of the group delayed in seeking medical advice for more than one year.

In the patients who explained their reasons for the delay, the following opinions were most frequently noted: "thought it was nothing to worry about," "thought it would go away," "afraid that it might be serious," "afraid that it might be cancer," and "afraid I might need surgery."

Thus it would seem that postmenopausal bleeding is still considered unimportant by many women and the publicity that is being so vigorously carried on to make women cancer conscious still has not reached or has not influenced a large proportion of women. Indeed some who perhaps have been reached have reacted conversely to their interests by avoiding physicians for fear they do have cancer.

#### *Doctor Delay.—*

Doctor delay indicates one month or more between the first consultation and diagnosis. Twenty-five patients, 23 per cent, evidenced some delay for which the doctor was directly responsible. This delay averaged ten months for the 25 patients, or 2.3 months for the entire series of 112 patients. The length of delay is shown in Table VI. The delay was six months or less in 50.5 per cent of the 25 patients, while 32.5 per cent delayed for seven to twelve months and 16.5 per cent delayed from twenty to thirty-six months. It is astonishing that three patients had delays of thirty-six months each, directly attributable to the doctor.

TABLE VI. PATIENT AND DOCTOR DELAY

NUMBER OF MONTHS	PATIENT DELAY		DOCTOR DELAY	
	NO. OF PATIENTS	PERCENTAGE	NO. OF PATIENTS	PERCENTAGE
1-3	27	41	13	50.5
4-6	15	23		
7-12	15	23		
24 plus	9	14	4	16.5
Total	66		25	
Average patient delay 8.6 months			Average doctor delay 10 months	

TABLE VII. CAUSES OF DOCTOR DELAY

	NUMBER OF PATIENTS
1. No examination and no treatment	7
2. No examination and local treatment	8
3. No examination and estrogens given	3
4. No examination and subtotal hysterectomy	1
5. Local cauterization (no diagnosis)	1
6. Local surgery (no diagnosis)	4
7. Local treatment with caustic solution (no diagnosis)	1
Total	25

The causes of delay in Table VII are similar to those expressed in other studies,<sup>31</sup> with the lack of a pelvic examination primarily responsible in 19



patients, 76 per cent, while, in the remaining 6 patients, local ineffectual treatment of some was carried out without a diagnosis being first established.

Only 27 of the 112 patients, 24 per cent, had no delay period, either of doctor or patient, and of these one must recall that ten patients were asymptomatic. The entire series of 112 patients experienced a five months' patient plus 2.3 months' doctor delay, or 7.3 months' total average delay.

### Clinical and Histopathological Description of Tumor

#### *Position of the Primary Tumor.*—

Realizing that tumors do not restrict themselves to one wall and that the written record is not always as accurate as one might hope, the tabulated results in Table VIII include some free interpretations and state only the primary wall or area involved if several were so invaded. Our results as shown are consistent with previous reports, with 45.7 per cent involvement of the posterior wall and 22.4 per cent of the anterior wall. Practically every author has stated that the lesion is most frequently found on the posterior wall and particularly the upper third. The figures for involvement of the posterior wall vary in the published reports from 40 to 65 per cent, and the anterior wall following in frequency with 15 to 25 per cent. In a composite group of 628 cases reported by Livingstone, the following percentages were given for the various sites: 59.9 per cent posterior wall, 17.8 per cent anterior wall, 10.8 per cent lateral, 8.3 per cent annular, and 3.2 per cent generalized. The only explanation so far offered for the frequency of the upper posterior wall as the site of the origin is that of Frank, who thought that the accumulation of irritating or macerating discharge in the posterior fornix may produce sufficient irritation to make this the most common area for malignant change.

TABLE VIII. POSITION OF VAGINAL CANCER

	UPPER THIRD		MIDDLE THIRD		LOWER THIRD		TOTAL	
	NO. PATIENTS	%	NO. PATIENTS	%	NO. PATIENTS	%	NO. PATIENTS	%
Anterior wall	9	8.0	6	5.4	10	9.0	25	22.4
Posterior wall	36	32.0	12	10.0	4	3.7	52	45.7
Right wall	3	2.8	2	1.9	5	4.5	10	9.2
Left wall	7	6.4	5	4.5	7	6.4	19	17.3
Annular or in vaginal vault	3	2.8	—	—	—	—	3	2.8
Total	58	51.7	25	22.3	26	23.2		
Generalized	3	2.8	—	—	—	—	3	2.8

#### *Clinical Description.*—

Primarily because of our lack of sufficient accurate information on the natural history of the lesion in its early stages, it has been difficult to classify the tumor into simple gross types. In many instances combinations of the various forms are present when the tumor is first seen.

In general, there are three basic types recognizable:

1. The everting, papillary, cauliflower or mushroom form, which possibly begins as a small papilloma and then develops into the fungating friable tumor so frequently present by the time it is first seen. This form readily undergoes

superficial necrosis and ulceration. In late stages ulceration may be so extensive as to produce an excavated crater. This form often extends only superficially into the surrounding tissues and at times may tempt the surgeon to perform simple excision.

2. The second form is the infiltrating type which may begin as a flat submucosal plaque and frequently extends along the wall for considerable distances with little or no growth in depth. Extension outward beyond the vagina tends to occur late.

3. The third form may be the later state of either Type 1 or Type 2, or may be a solitary nodule which ulcerates early to produce a typical excavated malignant ulcer with little adjacent infiltration.

From our data an attempt was made to classify the gross types by the most obvious features at the time it was first diagnosed. We find that 50 cases were infiltrating, 35 ulcerating, and 25 papillary in form. One case was not described and one case had been treated by other physicians and no visible tumor was seen at the time the patient first visited our clinic. We did not feel that further classification or comparison of the gross types to survival rates would be of additional value.

In all three forms fistulas are a late feature. The tumors are practically always solitary lesions. In only one of our group could multicentric foci be demonstrated. Although it is difficult to gather such information statistically from our records, it appears that many of the tumors are more or less ovoid in shape with the long axis parallel to the long axis of the vagina. It is often noted that infiltration beyond the vaginal wall occurs late and that spread along the wall toward the vault of the vagina is more frequent than toward the vulva.

The size of the vaginal cancer was reported in 76 patients and is given in Table IX. The remaining 36 patients most frequently had lesions larger than 6 cm. but the descriptions did not contain accurate measurements.

TABLE IX. SIZE OF VAGINAL CANCER

SIZE	NUMBER OF PATIENTS
1 cm.	12
2 cm.	30
3 cm.	22
4 cm.	4
5 cm.	2
6 cm.	6
Unclassified	36

The spread of the tumor will be described in two parts, that of the local extension which was more accurately recorded and the metastatic disease which unfortunately was not always as completely described as we might have liked. This was partly due to the fact that the earlier patients did not have routine chest films done. These extensions and metastases include those seen on initial examination or during the course of observation.

The most common direct extension was into the paravaginal or broad ligament areas which was found in 19 patients, followed by cervical involve-

ment subsequent to initial examination in 14 cases, rectal invasion in 9, bladder invasion in 5, urethral in 3, and vulval in 3 cases.

The metastatic sites were as a whole infrequent beyond the local inguinal and pelvic lymph nodes. Inguinal nodes were involved in 18 cases, 16 per cent, but because of the comparatively few autopsies performed in the group, no accurate data on internal lymphatic involvement were obtainable. It is interesting to note that in none of the patients with inguinal metastases was tumor found in the upper third of the vagina alone. The bone was the site of metastatic disease in 4 cases, once each to ilium, sacrum, femur, and metatarsal bones. The lungs were involved in 3 patients and the liver in only one.

#### *Histopathology.*—

Table X shows the histological types and percentages of our vaginal cancers. No adenocarcinomas are included since we found insufficient evidence that any of our adenocarcinomas were of primary vaginal origin. While there is little dispute that the commonest histopathological form of vaginal cancer is squamous or epidermoid,<sup>32-36</sup> a good deal of controversy still exists regarding primary adenocarcinoma of the vagina.<sup>37, 38</sup>

TABLE X. HISTOLOGICAL TYPES

TYPE	NUMBER OF PATIENTS	PERCENTAGE
1. Squamous	109	97.3
2. Leiomyosarcoma	2	1.8
3. Fibrosarcoma	1	0.9

There are five theories advanced for the presence of primary adenocarcinoma but all of them are very difficult to prove. The most frequently presented idea is the one originated by Meyer, who felt that primary vaginal adenocarcinoma was derived from misplaced mesenchymal cells in the vaginal wall, most probably from Müllerian rests due to faulty development. Broders felt that primary vaginal adenocarcinoma was derived from the basal layers of the pavement epithelium of the vaginal mucosa by metaplasia but there has been little popularity for this theory. Moench states that primary vaginal adenocarcinoma is preceded in some cases by adenomyoma of the rectovaginal septum. Others feel this type of tumor is derived from aberrant cervical glands in the fornix. The fifth theory is that adenocarcinoma is a malignant change in a pre-existing adenosis of the vagina.

Adenosis or adenomatosis of the vagina is the term employed for the presence of mucus-secreting glands in the subepithelial layers of the vagina and is extremely rare. It was first described by Bonney and Glendenning.<sup>39</sup> There have been very few reports other than this on this condition.<sup>40</sup> The lesion may be circumscribed or diffuse. Sometimes the glands coalesce to produce cysts. The patient is usually asymptomatic if the epithelium over the glands is intact, but if the vaginal surface is destroyed there is a characteristic copious discharge, feeling of heat in the vagina, and bleeding on touch. A more advanced state of this condition described by Plaut and Dreyfuss<sup>40</sup> is that of a

red cauliflower-like mass which is clinically indistinguishable from carcinoma. Those cases of adenosis that have reportedly progressed to carcinoma have all been of a relatively benign grade of adenocarcinoma (Grade I).

There has been an interesting case of adenocarcinoma reported by Ritchie<sup>41</sup> in a woman who had a Baldwin operation for congenital aplasia of the vagina. Thirteen years after the loop of gut had been transplanted, adenocarcinoma developed there. Ritchie postulates that this shows the effects of chronic irritation on misplaced gut wall and that possibly this is the same reaction which occurs on the squamous vaginal epithelium. However, we must ask whether the carcinoma might not have developed in the loop had it not been transplanted. We feel that the occasional reports of primary vaginal adenocarcinoma should be looked upon with suspicion as they are probably metastatic in origin.

Primary sarcoma of the vagina is the third reported pathological type of vaginal cancer and is very rare.<sup>42, 43, 44</sup> It is stated that this tumor is more frequently seen in childhood, developing from misplaced embryonal mesenchymal cells but can also develop in the connective tissues of the adult vagina.

TABLE XI. PATHOLOGICAL GRADE OF CARCINOMA

GRADE	CANCER OF CERVIX		CANCER OF FUNDUS		CANCER OF VAGINA	
	NO. OF PATIENTS	%	NO. OF PATIENTS	%	NO. OF PATIENTS	%
I	127	11.2	321	40.7	8	7.3
II	363	32.0	211	26.6	15	13.8
III	414	36.5	140	17.8	24	22.0
IV	230	20.3	114	14.7	61	56.0
Unclassified					1	0.9
Total	1,134	100.0	786	100.0	109	100.0

The pathological grading of the squamous carcinomas, according to Broders, is reported in Table XI and is compared with the grading of cervical and fundal carcinoma previously reported from our clinic. Our pathological grades for vaginal cancer are similar to those reported by most authors, who report the greatest number to be in the higher grades (III or IV). However, Livingstone and Emmert disagree. The former found only 2.9 per cent in Grade IV and the latter 0 per cent. Suffice it to say that the distribution of the pathological grades in our squamous vaginal carcinomas is the direct reverse of fundal carcinoma grades and bears little relationship to the pattern for cervix cancer.

TABLE XII. RELATION OF PATHOLOGICAL GRADE OF SQUAMOUS CANCER TO SURVIVAL RATE

GRADE	NO. OF PATIENTS IN GRADES	NO. OF PATIENTS SURVIVING 5 YEARS WITH NO EVIDENT DISEASE	SURVIVAL RATE
I and II	12	4	33.3
III and IV	60	19	31.6
Total	72	23*	32.0

\*One of the 24 five-year survivals had sarcoma.

In Table XII the relation of the pathological grade to the survival rate is shown. It appears there is little correlation between Broders' grading and



survival rates for vaginal cancer. This is similar to previous findings in cervical cancer but not in agreement with fundal carcinoma where there is a strong direct relationship between grade of the tumor and prognosis.

*Clinical Classification.*—

A satisfactory clinical classification for vaginal cancer into groups such as is utilized for cervix and fundus carcinoma (International Classifications) has not so far been presented. We have employed a simple classification for this series:

Group I. Limited to the vagina, including extension to the periphery of the cervix, rectovaginal septum, or immediate paravaginal tissues.

Group II. Extent beyond this into the pelvis, beyond the pelvis, or involving other organs.

Group III. Secondary cases, that is, those patients first treated elsewhere and subsequently referred to us.

Table XIII shows the number of patients and percentage in each group and the five-year absolute survival for Group I and II. Sixty-three and four-tenths per cent of the entire series were in Group I, 29.4 per cent in Group II, and 7.2 per cent were in Group III. Excluding the cases since 1947, the five-year absolute survival rate is shown as 36.5 per cent for Group I and 21.3 per cent for Group II.

TABLE XIII. CLINICAL CLASSIFICATION

GROUP	NO. OF PATIENTS	PERCENTAGE	NO. OF PATIENTS 1919-1947	ABSOLUTE 5 YEAR SURVIVAL	
				NO. OF PATIENTS	PER- CENTAGE
I	71	63.4	52	19	36.5
II	33	29.4	23	5	21.3
III*	8	7.2	—	—	—

\*Cure rates for Group III patients not included since they were previously treated elsewhere.

**Treatment**

From 1826, when vaginal cancer was first described, until the 1890's, there was no effective treatment for this disease. Then several men including Christian Fenger<sup>45</sup> and C. H. Roberts<sup>46</sup> independently attempted to extirpate the lesion surgically. In 1905, Wertheim attempted to cure vaginal cancer by the abdominal approach. Fritsch and Kelly<sup>62</sup> both advocated a sacral approach to surgery. In 1923, Holland,<sup>47</sup> Stevens,<sup>48</sup> and Dougal<sup>49</sup> each presented a case treated by the Wertheim procedure. From the beginning surgery has produced only a few long-term survivals when used alone. Even today, with the best of techniques, the primary surgical mortality is prohibitive, 10 to 15 per cent, and 90 per cent of the survivors show recurrence of the tumor postoperatively.<sup>50</sup> In fact, no extensive series of surgically treated patients has yet appeared.

Following the advent of radium at the turn of the century, there was little or no use of this modality in internal cancer until Alexander Graham Bell offered the suggestion for its use in this manner to a physician friend in 1903.

From that time onward radium combined with roentgen rays has become the most frequently used form of therapy. Radiotherapy has been shown to have a much wider range of applicability than even the most radical surgery.

Several authors<sup>51-56</sup> have described various forms of radium applicators for use in the treatment of vaginal cancer including unfiltered glass tubes of radium emanation, filtered radon seeds, radium needles, radium ovoids or bombs, dental compound molds containing radium, tandem tubes and others alone or in combination with external radiation. Our group of patients, running as it does from 1919 to the present, includes some patients who were treated by practically all of these methods but all of our patients were treated primarily by irradiation.

We feel today that the optimum therapeutic plan is to treat the lesion locally, either by surface applicator, or by the use of interstitial needles of radium. This may or may not be followed by x-ray therapy, depending upon the extent and character of the lesion. The difficulty in treating these lesions locally is not their inaccessibility or radioresistance, but the high degree of radiosensitivity of the bladder and rectal mucosa. Thus many local treatments in the past have been far too inadequate for fear of fistula formation. Because of the extreme variations in the size, shape, position, and depth of the lesions, the technique and dosage must be calculated for each patient. This is done to determine accurately the gamma roentgen dosage at various distances from the source to assure a cancerocidal dose to all parts of the tumor and not exceed the safe dosage to the rectal and bladder mucosa. Thus it is virtually impossible to standardize accurately, much less describe, the precise methods and dosages of local treatments in these patients.

In general, for a flat superficial lesion, a surface applicator of either a single 50 mg. radium source in a Duralumin applicator 1 cm. thick or two such applicators in parallel would be placed on the tumor without anesthesia and packed with gauze to hold the radium in the desired position on the tumor and away from other tissues. No sutures are necessary. Generally speaking, with a single 50 mg. applicator we would deliver about 7,500 gamma roentgens as a surface dose or 3,800 gamma roentgens at the 2 cm. mark from the surface.

For thicker tumors interstitial radium needles are used. The size, shape, and mass of the lesion are determined and sufficient 1 or 2 mg. radium needles of 1 cm. length (or more if used in tandem) are placed 1 cm. apart in the mid-plane of the tumor. With the interstitial method, approximately 5,000 gamma roentgens at the 0.5 cm. mark beyond the edge of the lesion is considered adequate.

If the lesion is more extensive than can be safely handled by radium alone, supplemental external x-ray is used either before or after the radium. Here again we are faced with the problem of standardization of treatment. The kilovoltage, filter, distance, size and position of ports, number of treatments, daily increment and total roentgen dosage varied quite frequently in past years for different patients, as would be expected. In general we use a 400 kv. machine but at times as little as 200 kv. and as much as 1,000 kv. have been used. At a standard distance of 70 cm. the beam is directed through multiple

pelvic ports of varying size converging on the vagina and broad ligaments. A half-value layer varying from 0.9 mm. Cu up to 9.0 mm. Cu has been used. Approximately 1,000 r tumor dose is given weekly in daily increments of 200 to 250 r. Treatment lasts for 5 to 6 weeks to deliver a total tumor dose of between 5,000 and 6,000 r from x-ray. Transvaginal x-ray has been used in a few patients where the vaginal cone could be placed to cover the lesion adequately. Generally, the use of this method in our experience is limited.

TABLE XIV. END RESULTS ACCORDING TO METHOD OF TREATMENT OF 75 PATIENTS TREATED COMBINED MODALITIES

SINGLE MODALITY			COMBINED MODALITIES		
TYPE	NO. OF PATIENTS	NO EVIDENT DISEASE IN 5 YEARS	TYPE	NO. OF PATIENTS	NO EVIDENT DISEASE IN 5 YEARS
1. Radium seeds	9	1	1. High-power x-ray and radium needles	3	1
2. Radium surface applicators	7	2	2. High-power x-ray and surface applicators	11	1
3. Radium needles	2	1	3. High-power x-ray and radium seeds	25	7
4. Radium seeds and radium surface applicators	2	1	4. High-power x-ray, radium seeds or needles, and radium tubes	9	6
5. High-power x-ray only	7	4			
Total	27	9—33.3%	Total	48	15—31.2%

Every patient in our series had treatment. The types of treatment for the 75 patients treated more than five years ago are shown in Table XIV. The types of treatment used for the group of 24 five-year absolute survivals without symptoms is also shown. There is little difference in the end results whether treatment was given by a single modality or by combined modalities. It is significant that 4 of 7 patients treated solely with high-power x-ray survived five years without symptoms. The surgical treatment group is discussed later under complications.

#### *Complications.—*

Most patients who had adequate radiation experienced some degree of immediate reaction in the bladder or rectum. In contrast, as best we are able to determine from the records, there were only 6 late rectal reactions, one late bladder reaction, 3 rectovaginal fistulas, and 2 vesicovaginal fistulas (4.4 per cent fistulas). There were perhaps some fistulas that developed terminally and were never seen by us in clinic and therefore not included. Only one of the 5 fistulas noted showed no disease present in the fistula while the other 4 were the result of extension of disease. The one fistula free of disease was operated on as described below. Livingstone reported ten fistulas in his series for a 9.1 per cent incidence, 6 rectovaginal and 4 vesicovaginal fistulas.

Four patients had surgical procedures following radiation failure but in none was surgery the primary treatment:

1. The first was a 64-year-old woman with a carcinoma of the upper posterior wall of the vagina that did not respond to high-power x-ray therapy and who was operated upon ten months after the first radiation treatment. A panhysterectomy, vaginectomy, and removal of the rectum were performed. The patient died six weeks postoperatively of pneumonia and at autopsy metastatic disease was found beyond the pelvis.

2. The second was a 48-year-old woman with a malignant leiomyoma originating in a fibroma of the vagina. She was treated with transvaginal x-ray therapy and local radium. Metastatic nodes developed one month after treatment and a left groin dissection was done. This was followed by high-power x-ray to both groins. The patient died of disease nine months after diagnosis and six months after the last treatment.

3. The third was a 62-year-old woman, who had been treated for a carcinoma of the upper left wall of the vagina with interstitial radium needles and high-power x-ray in supposedly adequate dosage. She was well for 13 months following treatment and then developed a recurrence in the left broad ligament and periurethral area. A complete pelvic exenteration was done with resulting colostomy and bilateral cutaneous ureterostomies. The patient withstood surgery well and was discharged from the hospital in good condition. Four months later, or six months after surgery, the patient committed suicide. No autopsy was performed.

4. The fourth patient was 35 years old and had a small lesion of the posterior fornix that was treated with a local radium applicator and high-power x-ray. The carcinoma did not respond but extended to the rectal wall. Surgery was advised and a total hysterectomy, bilateral salpingo-oophorectomy, excision of the upper third of the vagina, and an iliac node dissection were done. Metastatic nodes were noted in the obturator fossa which were technically impossible to remove at surgery. She received a further course of high-power x-ray therapy postoperatively which apparently arrested her disease. However, a large rectovaginal fistula developed, the margins of which were negative to biopsy and which necessitated a colostomy. She is now alive and well three months after colostomy, nine months after surgery, and thirteen months after diagnosis and initial radiation.

### Results

The eight secondary cases or Group III patients are excluded from our results. Also the 29 patients from 1948 to 1952 are excluded because of insufficient time since treatment, leaving a total of 75 patients. Table XV gives the survival times for these patients. The figures are for absolute survival through the fourth year. Five- and ten-year figures are for absolute survival without symptoms (cure). The five-year symptom-free rate is 32 per cent (24 patients). The ten-year symptom-free rate is 24 per cent (18 patients). Of the 6 patients in the five-year survival rate not shown in the ten-year rate, three have died of intercurrent disease other than cancer and three are alive and symptom free but have not yet reached ten years since diagnosis and treatment.

Five years after diagnosis, 36 of the 75 patients have died of disease, 12 have died of other diseases than cancer, 3 were lost to follow-up, and none were alive with disease. Since so many authors inadvisably eliminate those patients lost to follow-up or who die of other causes before the fifth year even though free of disease at the time of death, we may also give a so-called corrected rate for such a "determinate" group of 60 patients: 24 patients survived five years, or 40 per cent. Relatively few patients succumbed between two and five years as shown by the difference in the 46 per cent survival at two years and the 32 per cent survival at five years.



TABLE XV. ABSOLUTE SURVIVAL RESULTS IN 75 PATIENTS, 1919-1947

SURVIVAL	NO. OF SURVIVORS	PERCENTAGE SURVIVAL
1 year or less	47	62.6
2 years or less	35	46.0
3 years or less	28	37.4
4 years or less	25	33.3
5 years, no evident disease	24	32.0, no evident disease
10 years, no evident disease	18	24.0, no evident disease

It is of interest to look at the survival of the asymptomatic group of patients. Two of these patients were in Group III and are not discussed here. One patient was in Group II and survived nineteen months. The other seven patients had Group I lesions and are alive and free of disease today. Only two of the seven, however, were discovered prior to 1948 and they have been eleven and twenty years with no evident disease.

Table XVI compares the absolute survival results in twenty-four other reports with our own. The range is wide from 0 to 45.5 per cent. Our result of 32 per cent is the highest of all but one of the groups reported.

TABLE XVI. ABSOLUTE SURVIVALS REPORTED PREVIOUSLY

AUTHOR	ABSOLUTE 5-YEAR SURVIVALS		
	NO. PATIENTS	NO. SURVIVALS	PERCENTAGE
1. Giesecke-Kiel, 1920	22	1	4.5
2. Bailey and Bagg, 1921	18	0	0
3. Broders, 1922	18	2	11.1
4. Moench and Stacy, 1922	37	3	8.1
5. Heyman, 1930	14	4	21.4
6. DeBüben, 1931	29	2	6.9
7. Philipp and Gornick, 1932	83	13	15.7
8. Healy, 1933	99	21	21.2
9. Nielson, 1933	26	0	0
10. Masson, 1934 <sup>57</sup>	80	18	22.5
11. Taussig, 1935	27	2	7.4
12. Berven and Heyman, 1936	58	6	10.4
13. DenHoed, 1936 <sup>58</sup>	31	3	9.7
14. Emmert, 1938	33	4	12.0
15. Courtial, 1939 <sup>59, 60</sup>	22	10	45.5
16. Johnston, 1942	3	0	0
17. Lederman and Mayneord, 1942	7	1	14.3
18. Livingstone, 1947	76	8	10.5
19. Way, 1948	25	5	20.0
20. Fricke, 1950	32	10	31.2
21. Messelt, 1952	78	17	22.7
22. Singh, 1952	21	0	0
23. Kaiser, 1952	38	9	13.0
24. Bivens, 1953	40	11	27.5
25. Roswell Park, 1953	75	24	32.0

### Summary

1. One hundred twelve patients with primary cancer of the vagina seen at Roswell Park Memorial Institute between January, 1919, and December, 1952, are presented.

2. The incidence was found to be 1.3 per cent of all gynecological cancer, with a ratio of one vaginal cancer to fifty-five cervical cancers.

3. The average age was 57.5 years for the whole group.

4. Three and six-tenths per cent gave a familial history of cancer.
5. The menses show little significant change from the normals. The average age of menopause was not abnormal.
6. Each patient had an average of 2.7 full-term children. Twenty-eight and four-tenths per cent of the group were nulliparous.
7. Third-degree prolapse was present in 3.6 per cent, a rather low incidence and is not thought to be a prime etiological factor.
8. Pessaries were thought to be a contributing factor in 4 patients.
9. The disease is uncommonly associated with pregnancy and pregnancy is not believed to be a primary etiological factor or to alter the prognosis seriously.
10. There is little evidence that associated general diseases are more prevalent in women with vaginal cancer or contribute to the production of the cancer.
11. Bleeding was the commonest symptom in 75 per cent, followed by pain in 37.5 per cent. Nine per cent were asymptomatic.
12. The average length of symptoms was 7.3 months. In only 16.3 per cent were symptoms present for less than one month at the time of the diagnosis. The usage of cytological diagnosis in this disease is noted.
13. Fifty-nine per cent of the patients delayed in seeking medical consultation for an average of 8.6 months.
14. Twenty-three per cent of the group evidenced doctor delay averaging ten months. The most frequent reason given was lack of a pelvic examination.
15. The position of the tumor in the vagina showed 45.7 per cent on the posterior wall and 22.4 per cent on the anterior wall.
16. The three main gross types of tumor are described. The size of the tumor, the direct spread and metastases are described. Sixteen per cent had inguinal node metastases.
17. The histopathologic types are noted, with squamous carcinoma occurring in 97.3 per cent. The most frequent pathological grades for this tumor were III and IV. No relation is found between pathological grades and survival rate.
18. A discussion of treatments in our patients is presented. All patients had primary radiotherapy. Four women had secondary surgical therapy.
19. The survival cases and complications of therapy are described.
20. A 32 per cent five-year absolute survival rate without symptoms for 75 patients up to 1947 is shown. A comparison is made with the results of other reports.

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## THE LOW TRANSVERSE MUSCLE-CUTTING INCISION IN GYNECOLOGICAL SURGERY\*

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A SATISFACTORY abdominal incision should (1) provide adequate exposure, (2) respect anatomical structures sufficiently to produce the least possible damage to the abdominal wall, (3) be simple and allow for extension, and (4) be cosmetically acceptable to the patient.

The transverse abdominal incision has been used over 100 years, but its advantages have not been sufficiently recognized for its universal adoption as the incision of choice. It is my purpose to point out the several basic advantages of this approach to pelvic lesions, and to recommend its more widespread use in gynecological surgery.

### History

The great French obstetrician Baudelocque<sup>1</sup> in 1823 was the first to describe a transverse incision of any type. He advocated it in the lower abdomen for use in cesarean section. Pfannenstiel,<sup>2</sup> however, in 1900 was the first to popularize its use in pelvic surgery. His incision has met favor with many gynecologists but some claim that it does not provide sufficient exposure.

In 1907 Maylard<sup>3</sup> advocated the transverse incision for all abdominal surgery and stated that transverse incisions "afford more room for the treatment of pelvic diseases." His incision differs from the Pfannenstiel incision in that all the layers of the abdominal wall, from the skin to the peritoneum, are divided in the transverse plane. In 1941, Cherney<sup>4</sup> described a modification of the Maylard incision. The main difference is that the rectus muscles are not divided transversely, but are cut at their insertion into the pubis and are resutured to this area on closure. We have employed, and advocate, the original Maylard incision, i.e., transverse incision of all layers, including the rectus muscles.

### Anatomy and Physiology

Any discussion of abdominal incisions must be based upon a number of anatomical and physiological considerations. For this reason certain practical points in the anatomy and physiology of the abdominal wall will be reviewed and discussed.

*Skin.*—Langer's lines of skin cleavage cross the anterior abdominal wall in a generally transverse direction. It is well recognized that skin incisions

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made parallel to these lines of cleavage result in much finer and firmer scars than do those which are made perpendicular to them.

*Muscle and Aponeuroses.*—The muscles of the anterior abdominal wall may be divided into the flat group and the anterior group. The fibers of the anterior muscles run vertically while those of the flat muscles run in an essentially transverse direction.

The flat muscles are from without inward: the external oblique, the internal oblique, and the transversus abdominis. The aponeurotic fibers of these muscles separate at the edge of the rectus muscle to enclose that structure and meet in the midline with those of the opposite side to form a firm, fibrous band, the linea alba. This division of the aponeuroses does not take place below a point situated about midway between the umbilicus and the symphysis pubis. Here the fibers pass in front of the respective recti and insert into the linea alba. The lower margin of the divided sheath is represented posteriorly by a well-defined lunated edge, known as the linea semicircularis. Below this line the rectus muscle is separated from peritoneum by the transversalis fascia and preperitoneal connective tissue.

The rectus sheath is commonly thought of by surgeons as a separate entity in the abdominal wall, the sole purpose of which is to enclose the rectus muscles. In reality it is formed by the aponeurotic fibers of the three flat muscles. These aponeurotic fibers are best thought of as the "little tendons"<sup>5</sup> of the flat muscles which insert into the linea alba and take their point of action in that structure. Thus the fibers of the rectus sheaths run transversely and a vertical incision through the sheath, or through the linea alba, must cut across the multiple tendons of the flat muscles.

The anterior group of abdominal muscles includes the recti and the pyramidalis. The pyramidalis muscles are frequently absent and play little part in abdominal incisions or in their closure. The rectus muscles do not extend uninterruptedly from origin to insertion, but are divided into segments by four transverse bands of fibrous tissue known as "tendinous inscriptions." These fibrous bands are firmly attached to the anterior rectus sheath and are arranged as follows: one at the level of the ensiform cartilage, the second between that point and the umbilicus, the third at the umbilicus, and the fourth between the umbilicus and the symphysis pubis. Because of these firm tendinous attachments of the rectus muscles to the anterior rectus sheath there can be only minimal retraction of the muscle fibers when they are cut transversely. When the rectus muscles are divided transversely, they heal by the formation of a fascial support similar to an additional tendinous inscription without functional impairment.<sup>6</sup>

Function of the abdominal musculature need not be discussed in detail but certain pertinent points deserve mention. Contrary to popular belief, the rectus muscle, which runs longitudinally in the abdomen, does not play the chief role in the production of increased intra-abdominal pressure. The flat muscles practically encircle the abdomen and by their contraction draw the linea alba posteriorly, decrease the circumference of the abdomen, and compress the abdominal contents. Strong contraction of the flat muscles is

necessary during normal expiration, and during the acts of coughing, vomiting, and defecation these muscles must contract vigorously in order to raise the intra-abdominal pressure. The muscle pull during respiration with the patient under light general anesthesia has been calculated by Sloan<sup>7</sup> as being between 30 and 50 pounds.

With these facts in mind we may readily see that any vertical incision will have at least 30 pounds of energy applied uninterruptedly toward wound disruption. With a transverse incision the opposite situation exists, that is to say, the muscle pull aids in closing the incision. Any surgeon who has closed vertical incisions with the patient straining under light anesthesia must remember the extreme difficulty with which the peritoneum and posterior rectus sheath is closed. Frequently this closure is so difficult that the peritoneum is shredded. This difficulty in closure is not encountered with transverse incisions.

*Nerve Supply.*—The anterior abdominal wall receives its nerve supply from the lower six intercostals together with the iliohypogastric and ilioinguinal nerves. These nerves course in a more or less transverse direction. While running forward between the internal oblique and transversus muscles, there is a rich anastomosis between them. Once the nerves have reached the lateral border of the rectus muscles, however, little if any anastomosis occurs. For this reason any incision which passes vertically through the rectus muscle or through its lateral border must denervate that portion of the muscle medial to the incision. On the other hand, transverse incisions through the rectus muscle result in the least possible damage to its nerve supply. Furthermore, transverse incisions encounter the nerves laterally where they are mobile and can be retracted.

*Blood Supply.*—The main blood supply is derived from the superior and inferior epigastric arteries. These vessels lie posterior to the rectus muscle and there is a rich anastomosis between them. They also freely anastomose laterally with the intercostal, lumbar, and deep circumflex iliac arteries. The inferior epigastric artery provides the largest single blood supply and frequently must be ligated in transverse incisions in the lower abdomen. The anastomotic blood supply is so rich, however, that there is no danger in this procedure. There is very little anastomosis across the midline and the linea alba is provided with the poorest blood supply of any area in the abdominal wall.

*Lymphatic Drainage.*—Lymphatic drainage of the lower abdomen is from the umbilicus downward toward the inguinal and pubic regions. The linea alba is almost destitute of lymphatics. In any transverse incision, the lymphatic vessels must be severed, but the ready absorption of exudates by means of abundant lymphatics promotes wound healing.

### Technique

As stated previously, we advocate the original Maylard type of incision. The technique used will be briefly described. The skin is incised in a

curvilinear fashion beginning about two fingerbreadths below and medial to the anterior superior iliac spine, crossing the midline just above the pubic hairline, and terminating below the iliac spine of the opposite side. Whenever possible, the wrinkle lines in the skin should be followed. The incision is developed through the subcutaneous tissue and anterior rectus sheaths. At either end of the incision the superficial epigastric vein is usually encountered, divided, and ligated.

The rectus muscles are transected over a finger inserted beneath them. The inferior epigastric vessels are usually found beneath the lateral third of the muscle and are transected and ligated. The peritoneal cavity is entered at either side of the midline. The index finger is inserted into the peritoneal cavity, the height of the bladder is ascertained, and the peritoneum is incised transversely about one fingerbreadth above the line of its reflexion from the abdominal wall onto the bladder. In the midline, the urachus is divided, and the rare instances of its patency should be kept in mind. When additional exposure is needed the incision may be extended by incising the oblique muscles either to the right or left, or both, as is necessary.

Closure of the incision is facilitated if the patient is flexed slightly, although this is usually not necessary. The peritoneum and transversalis fascia are closed as a single layer using chromic catgut suture material. A continuous mattress type stitch is used to evert the cut edges carefully so that smooth serosa meets smooth serosa and exact approximation is obtained. This is essential if postoperative adhesions to the abdominal wall are to be avoided. Furthermore, inexact peritoneal closure may lay the groundwork for subsequent entrance of a wedge of omentum or bowel which may proceed to separate the layers of the abdominal wall and result in herniation or disruption of the wound.

Suturing of the rectus muscle itself is not only difficult and unsatisfactory, but entirely unnecessary. When the anterior rectus sheath is approximated the edges of the muscle will be in close proximity.

The aponeurotic layers of the abdominal wall represent the only portion of the closure in which real strength is obtained at the suture line. The anterior rectus sheath and the muscle and aponeurotic layers lateral to the sheath are closed separately with interrupted silk sutures. Interrupted sutures are used because they impart the greatest strength. Nonabsorbable suture material is the most dependable to allow sufficient time for firm wound healing to take place.

Scarpa's fascia being a definite fascial layer presents the only layer in the abdominal subcutaneous tissues which can readily be sutured. This is closed with interrupted sutures of fine silk or chromic catgut. These sutures are used only to obliterate dead space for they add nothing to the strength of the wound. Skin closure is accomplished with interrupted sutures of fine silk. Stay sutures and incisional drains are not used under any condition.



### Material

The operative records of all pelvic laparotomies performed on the Gynecological Service at the Louisville General Hospital in 1951 and 1952 were reviewed. The type of incision used is listed in Table I. During this two-year period there were 388 pelvic laparotomies done, and in 96 of the cases, or 25 per cent, a Maylard type of incision was used.

TABLE I. TYPE OF INCISION FOR PELVIC LAPAROTOMY AT LOUISVILLE GENERAL HOSPITAL

TYPE	1951	1952	TOTAL
Vertical	183	101	284
Maylard	27	69	96
Pfannenstiel	1	4	5
Cherney	3	0	3
Total	214	174	388

The increasing popularity of this type of incision can be noted in Table II. In 1951 the Maylard incision was used in only 12.6 per cent of pelvic laparotomies performed. In 1952, 40 per cent of pelvic laparotomies were done through this incision, and during the first three months of 1953 it was used in 50 per cent of cases.

TABLE II. MAYLARD INCISION FOR PELVIC LAPAROTOMY AT LOUISVILLE GENERAL HOSPITAL

	1951	1952	1953*
Number	27	69	26
Per cent	12.6	40	50

\*First 3 months only.

The hospital charts of the 96 patients upon whom pelvic laparotomy was performed through a Maylard incision were reviewed and the following data tabulated (Table III): Eighty-six patients were Negroes while 10 patients were white. The average age was 36 years. The mortality rate was 1.04 per cent, one patient having died during the postoperative hospital stay. The cause of death was adenocarcinoma of the fundus with generalized metastases. Stay sutures were not used in a single case. Subcutaneous drains were used in 2 instances.

TABLE III. GENERAL INFORMATION

No. of patients (Maylard)	96	
Negro patients		86
White patients		10
Average age	36 years	
Mortality	1	
Stay sutures	0	
Incisional drains	2	

The type of operation performed upon these patients is listed in Table IV. The procedure most frequently performed was a total hysterectomy. The appendix was removed in 79, or slightly more than 82 per cent, of these cases. The results indicate that the appendix can be safely removed in the average pelvic operation. Accidental injury to the ileum required resection in 1 instance and enterorrhaphy in another.

As noted in Table V, there was a complete absence of postoperative pulmonary and peripheral venous complications. The incidence of intestinal distention due to adynamic ileus was very low. There were 2 cases of entero-



cutaneous fistula. One of these was the result of accidental perforation of the ileum in a patient with peritoneal, intestinal, and pelvic tuberculosis. The other followed removal of a laparotomy pad which had been left in the peritoneal cavity at a previous operation. These 2 patients developed peritonitis and wound infection but these complications cannot be attributed to the type of incision used. An additional patient developed a wound hematoma. Four patients had postoperative urinary retention and this was the most common complication. All 4 responded readily to bladder catheterization. There was not a single case of wound disruption or evisceration requiring secondary closure. Adequate follow-up in the way of return clinic visits was obtained on all patients. The period of follow-up ranged from 4 months to 24 months and only 1 case of incisional hernia was discovered. This occurred in the patient who developed a wound infection as the result of a hematoma.

TABLE IV. OPERATIONS PERFORMED

<i>On Uterus.—</i>	
Hysterectomy	79
Myomectomy	3
Suspension	3
Fundectomy	1
Trachelectomy	1
Partial or complete adnexectomy	65
<i>Miscellaneous Procedures.—</i>	
Appendectomy	79
Presacral neurectomy	1
Partial pelvic lymphadenectomy	2
Resection of ileum	1
Enterorrhaphy	1
<i>Vaginal Procedures Done at One or More of the Above Operations.—</i>	
Dilatation and curettage	3
Repair of cystocele	2
Repair of rectocele	6
Urethral diverticulectomy	1

TABLE V. POSTOPERATIVE COMPLICATIONS

	NO.	PERCENTAGE
<i>Pulmonary.—</i>		
Atelectasis	0	
Pneumonia	0	
Embolism	0	
Thrombophlebitis	0	
<i>Intestinal.—</i>		
Obstruction	0	
Distention	3	3.1
Fistula	2	2.08
Peritonitis	2	2.08
Urinary retention	4	4.1
Wound infection	3	3.1
Wound disruption	0	
Evisceration	0	
Hernia	1	1.04

For comparative purposes, the lower abdominal incisional hernia repairs done during this two-year period were reviewed (Table VI). There was a total of 11 incisional hernias in the lower abdomen repaired and 8, or 73 per

cent, of these occurred in vertical incisions. Gynecological operations had been performed in 6 of these 8 patients. Two transverse incisional hernias were repaired during this period and only 1 of these resulted from previous pelvic surgery.

TABLE VI. LOWER ABDOMINAL INCISIONAL HERNIA REPAIR AT LOUISVILLE GENERAL HOSPITAL, 1951 AND 1952

TYPE INCISION	NO.	ORIGINAL OPERATION		
		GYN.	GEN. SURG.	G-U.
McBurney	1		1	
Vertical	8	6	2	
Transverse	2	1		1
Total	11	7	3	1

### Advantages and Disadvantages

Recognition of the several advantages afforded by the transverse incision accounts for its increasing popularity at our institution. These advantages are as follows:

*Better Exposure.*—When a vertical incision is made, the open wound must be stretched into a transverse aperture and this causes considerable trauma to the tissues. When a transverse incision is used the center rather than the end of the incision is over the operative field and such distortion of the wound is unnecessary. Also, the transverse diameter of the lower abdomen is usually about 25 per cent longer<sup>4</sup> than the distance between the umbilicus and the symphysis pubis, and the exposure afforded by a transverse incision is proportionally larger unless the vertical incision is extended above the umbilicus. Inasmuch as the overhanging fold of fat found in very obese persons is above the level of the transverse incision, it is not in the surgeon's way and the depth of the wound is considerably decreased.

The objection has been offered that the transverse incision cannot be extended to take care of pathology in the upper abdomen. Our primary purpose in gynecological surgery is to expose the uterus, tubes, and ovaries and not general exploration of the abdominal cavity. The liver, gall bladder, and stomach can be easily palpated and the appendix easily removed through the low transverse incision. Should exposure of another portion of the abdominal cavity seem advisable, two good incisions are much better than one poor one.

*Easier Closure.*—The edges of a transverse incision tend to come together naturally, thus aiding closure of the incision. If tension on the wound edges should be present, this can be remedied by simple postural change. This is not the case in vertical incisions.

*Stronger Wound.*—A number of studies have shown that the incidence of evisceration and herniation is very much lower in the transverse type of incision.<sup>8, 9, 10</sup> The greater strength of the abdominal wall following this approach results from three factors: (1) better blood supply with consequent better healing, (2) no denervation of muscle, and (3) absence of strain on the suture line (direction of the incision parallels the direction of pull of the oblique muscles).

*Less Incisional Pain.*—Even a limited experience with transverse laparotomy will convince the surgeon, who has not previously used this method of approach, that patients have much less pain during the postoperative period. The transverse wound is less painful because nerve injury is avoided and the aponeuroses are not transected. Vertical incisions injure the intercostal nerves and these sectioned nerves are hyperirritable during the early postoperative course.

*Lower Morbidity and Mortality.*—With an almost complete absence of evisceration, herniation, thrombophlebitis, and pulmonary complications, the mortality and morbidity are necessarily lower. In vertical incisions the postoperative hyperirritability of the nerves causes the patient subconsciously to splint the abdominal wall in an effort to minimize pain. This splinting of the abdomen reduces the excursions of the diaphragm and a decrease in vital capacity results.<sup>11</sup> This decreased ventilation favors the development of anoxia and atelectasis as well as pneumonia. Also when a vertical incision has been used the incisional pain and splinting which result interfere with coughing, and the elimination of secretions from the tracheobronchial tree is reduced. The accumulation of these secretions favors the development of atelectasis and pneumonia. Because of the minimal amount of pain associated with transverse incisions, early ambulation is more easily accomplished and this reduces both pulmonary and venous stasis. The combination of relatively painless motion, respiration, and coughing explains the low incidence of pulmonary and peripheral venous complications.

In regard to wound infection, we believe that the transverse incision handles contamination or frank infection better than the vertical incision. Not only does the increased blood supply to the area enable the tissues to combat infection more efficiently, but pus, when it occurs, can readily be drained from the lateral dependent angles of the wound. With the patient lying in bed the vertical incision is in a plane of the abdomen which is level throughout its length, and no matter how widely the wound is opened, pus will necessarily collect in the middle of the incision. Thus, dependent drainage is readily established in the transverse wound but is almost impossible to accomplish in the vertical wound.

Delayed complications of laparotomy, such as abdominal adhesions, frequently constitute a more serious problem than the original operation. Sprengel<sup>12</sup> noted when doing autopsies that it was rare to find adhesions to a transverse incision, whereas it was relatively common in vertical incisions. Other writers<sup>13, 14</sup> have also pointed out that adhesions are less frequent in transverse incisions. This may be explained by inexact peritoneal closure due to the presence of lateral tension as well as the greater damage to the nerve supply of the peritoneum.<sup>15</sup> The value of fewer peritoneal adhesions is better appreciated when it is realized that adhesions are the most common cause of acute intestinal obstruction and that this carries a mortality rate of about 26 per cent.<sup>16</sup>

*Better Cosmetic Results.*—An outstanding feature of the transverse incision is the hairline scar which results. This is an indication of more com-

plete healing as well as evidence of a good cosmetic result. With the recent popularity of fashions exposing the midriff, the cosmetic end result of abdominal incisions is becoming of more importance.

*Disadvantages.*—The one disadvantage to this incision is that it takes more time to enter the peritoneal cavity. For this reason it is not recommended for emergency laparotomy, such as ruptured ectopic pregnancy or other instances of intraperitoneal hemorrhage.

### Summary

1. A review of 96 cases of low transverse abdominal incisions of the Maylard type performed on the Gynecological Service at the Louisville General Hospital is presented.

2. This incision is based upon sound anatomical and physiological principles and offers the following clinical advantages: (1) better exposure, (2) easier closure, (3) a stronger wound, (4) less incisional pain, (5) lower morbidity and mortality, and (6) better cosmetic results.

3. Except for emergency laparotomy, the transverse incision is the most logical approach to pelvic pathology and should be used more frequently by the gynecological surgeon.

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## DIABETIC VULVOVAGINITIS TREATED WITH VITAMIN E SUPPOSITORIES

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ONE of the most distressing and difficult complications of diabetes is diabetic vulvovaginitis and its treatment. The onset of the disease may be slow or sudden, even in treated diabetics. However, in untreated cases, it is frequently the symptoms of diabetic vulvovaginitis that first bring women to the physician for relief. The patients complain of marked discomfort with severe vaginal and vulvar burning and itching, the latter often being irritated further by scratching. The process may extend to involve even the inguinal regions and inner thighs.

Examination of these cases usually shows the tissues to be dehydrated, inflamed, swollen, and tender with burning and itching extending to the surrounding tissues of the labia, vulva, and urethra. The vaginal outlet often becomes crusted from continued scratching by the patient. An erythematous, inflammatory eruption usually appears over the whole vulva and adjacent areas and becomes eczematous.<sup>1</sup> Frequently there are marked leukorrhea and mixed infections, including monilial, the latter often aggravating or prolonging vulvar infections.<sup>1</sup> Pain, discharge, and ulcerations may develop, as well as burning on urination and urinary frequency.

Parrott and Miller<sup>2</sup> state that the true nature of diabetic vulvitis is a "yeast vulvitis," but also believe other factors are contributory. They noted that the vulval tissues of fairly well-controlled diabetics often showed some degree of erythema and secondary infection and believe that any condition increasing the sugar content of the environment, e.g., diabetes or pregnancy, may excite dormant *Monilia* to pathogenic activity. These authors further state that "diabetic vulvitis is in fact a vulvar moniliasis" and presents a scant, relatively dry, flaky discharge which is of cottage-cheese or bread-crumbs consistency. The vulva shows deep erythema with overlying grayish cast somewhat resembling a second-degree burn. In early cases, the findings are chiefly in the posterior vulval segment and about the perineal body but, subsequently, show diffuse involvement. In those areas removed from the vaginal secretion, these authors have noted a papulosquamous skin eruption with dry, flaky, thin scales interspersed with multiple small fissures and excoriations. Pruritus is the most common and consistent associated symptom.

Inflammation and infections of the female genital tract have long been treated by various therapeutic regimes, systemic and local. Vaginal therapy has been limited to antiseptic and prophylactic measures to combat bacterial invasion and to the administration of hormones. Unfortunately, the use of antiseptic, antibiotic, and hormonal therapy in diabetic vulvovaginitis has

produced generally poor results. Of late, antibiotic therapy has been reported to precipitate symptoms of vulvovaginitis and pruritus ani. The author has especially observed this syndrome in the diabetic. Despite rest and insulin and various local applications and douches, the vaginal complaints often persist or are slow in responding to therapy. Warner<sup>3</sup> believes that successful therapy depends on the eradication of bacterial pathogens and the restoration of the vagina, cervix, and endocervix to their normal histologic status.

The various experimental and clinical work on the effects of vitamin E on tissues of the female genital tract is admittedly controversial and some of it not yet conclusive. In 1949, Butterini<sup>4</sup> reported that vitamin E treatment of diabetes mellitus increased the differential between arterial and venous glycemia and reduced the hyperglycemia and glycosuria. He found that, in mild forms of diabetes, the metabolic changes could be cured with the use of vitamin E alone. In severe cases, vitamin E increased the intensity and duration of the hypoglycemic effect of insulin. These observations have not been generally corroborated.

Among the recent reports on studies of vitamin E and metabolic disturbances, Filer and associates<sup>5</sup> concluded that diabetes and nephrosis, which are accompanied by hypercholesterolemia, have an associated tocopherolemia, and that the tocopherol absorption test may be used to demonstrate the impaired absorption of fat and fat-soluble vitamins by patients with fibrocystic disease, celiac syndrome, and some cases of diarrhea.

Kaunitz and Slanetz<sup>6, 7</sup> studied the influence of alpha tocopherol on the implantation of old rats and found that the vitamin E requirements of rats increased with age, and that increased tocopherol is required during the rats' menopause. These authors also noted that alpha tocopherol improves the regularity of the estrous cycle in rats from infrequency to normalcy. In treating the female diabetic patient, we find that diabetic vulvovaginitis is most common during the menopause and in later life, which would seem to substantiate a relationship between diabetic vulvovaginitis and tocopherolemia.

Current literature on vitamin E and its effect on the female genital tract presents evidence which indicates that the deposition of pigment in the E-deficient animal prevents the peroxidation and polymerization of unsaturated fatty acids due to the decrease in tissue tocopherols, which act as antioxidants. Atkinson<sup>8</sup> feels that, whether or not this represents the complete mechanism of pigment accumulation, it seems inescapable, from these observations, that the effects of ovarian hormones on uterine pigmentation are mediated through their regulatory function in the metabolic processes of the tissues of the reproductive tract.

Experiments on laboratory animals by Joller<sup>9</sup> have shown that vitamin E is of importance in the resistance to infection. This was also noted by Kaunitz and Slanetz.<sup>6</sup> They stated that infections of the uterus and the tubes were frequently observed by them in the older rats on the deficient diet.

Similar observations have previously been reported by Emerson and Evans.<sup>10</sup> In some instances, the uterus contained 5 to 10 c.c. of thick purulent material. Purulent fistulas in the inguinal region, originating from uterine infections, were observed four times. No purulent infections were noted in the rats on the complete diet. While infection of the genital organs may have prevented pregnancies in some of the rats, its occurrence can be excluded in those rats which responded to the single postmating dose of alpha tocopherol. Infection of the uterus and tubes would have interfered with both the fertilization and the implantation of the ovum.

Faria,<sup>11</sup> in 1946, stated that vitamin E-deficient rats showed a development of fibrosis in the endometrium, but felt that this might be due to advancing age rather than to a vitamin deficiency. However, as noted previously, Kaunitz and collaborators,<sup>6, 7</sup> in 1947 and 1949, found that vitamin E requirements increased with age. An increase in connective tissue of the uterus, cervix, and vagina of rats in advancing age was reported by Wolfe and associates.<sup>12</sup> Further confirmation of this fact was made by Fuhr and his co-workers,<sup>13</sup> who studied tocopherol requirements during the rats' menopause. These authors felt that it was very probable that the reproductive disturbances of the rat in vitamin E deficiency are due to uterine rather than to ovarian change. This uterine dysfunction is accompanied by the presence of fibrosis and pigment.

The lack of adequate treatment and satisfactory results led us to review the recent studies on the etiology and physiology of vaginal diseases. These seemed to point toward metabolic factors causing deficiencies or impaired absorption as the underlying basis for some of these conditions, especially diabetic and senile vulvovaginitis. It was felt that by replacing a deficient substance, and by increasing the needed metabolic supply, normal function could be restored.

Our series consists of 24 diabetic patients with symptoms and signs of diabetic vulvovaginitis, as well as 20 patients who were nondiabetic but presented varied metabolic conditions with evidence of disturbed carbohydrate metabolism and symptoms relating to the vulvovaginal tract. I employed vitamin E vaginal suppositories in these patients on the premise that vitamin E acts as a decongestant and antioxidant and thereby reduces localized edema. It increases the barrier against infection and stimulates a more even subcutaneous connective tissue of the skin and underlying mucosa. During inflammation, the lack of vitamin E may cause contracture and delayed healing of connective tissue, mucosa, submucosa, or muscle sheaths.

The use of vitamin E vaginal suppositories containing wheat germ oil and tocopherol in a new, dispersable, very slowly soluble base, in vaginal disease was partly suggested by the mucocutaneous character of the vulvovaginal tract. The base contained no local anesthetic and no cocoa butter or similar fats. It was nonirritating, water miscible, and allowed greater spreading and absorption of vitamin E.

It was found that this mode of treatment had a very soothing effect and within a few days a change in the skin and mucosa was visible. The patients

received vitamin E vaginal suppositories at least once daily. Such symptoms as redness, swelling, and congestion were reduced or alleviated. External applications of vitamin E preparations to the vulva and surrounding tissues for the treatment of a secondary dermatitis or scratching injuries was only palliative. Complete relief of symptoms and healing was obtained only by the direct vaginal application of vitamin E suppositories. In three of the cases, included in the 44 of the series, the base alone was used, with no effect.

Although further investigation is required, I believe that the clinical results obtained in this series\* of 44 cases of vulvovaginitis with the use of vitamin E vaginal suppositories warrants this report. In all the patients, improvement was moderate to marked, with excellent and rapid results in cases of leukorrhea, vaginal and vulvar itching and burning. No toxic side effects were observed.

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\*Tabulation of the initial complaints, findings, and results obtained in this series of 44 cases will be available in full in the reprints of this article.



## A CRITICAL EVALUATION OF THE RICHARDSON PREGNANCY TEST

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SINCE its introduction in 1939,<sup>1</sup> the Richardson pregnancy test has been used successfully and also unsuccessfully in many thousands of cases. Several criticisms have appeared in the literature,<sup>2-5</sup> and one paper has appeared which, while not achieving the precise accuracy reported by Richardson, nevertheless indicated the inherent usefulness of the procedure.<sup>6</sup> This communication will present a critical analysis of over 1,000 cases in which the Richardson technique has been employed and will point out certain clear-cut areas of technique which must be strictly adhered to in order to make the procedure useful in determining early pregnancy. There are definite factors which must be controlled very carefully, but which, when controlled, enabled us to achieve the high degree of accuracy reported by Richardson. It is interesting to note that these factors are all alluded to in Richardson's article, but seem to have been forgotten, or at least minimized, in most, if not all, of the subsequent critical articles. These factors can be categorized as follows:

- I. Factors pertaining to the subject
- II. Factors pertaining to the reagents
- III. Factors pertaining to technique
- IV. Factors pertaining to the sample

It is the purpose of this communication to assess the importance of deviations from the original Richardson technique in relation to the reliability of the test. In order to arrive at an understanding of terms, the following definitions were agreed upon:

1. *A Correct Positive.*—This is a test performed upon the urine of a woman in her first trimester who was definitely pregnant as shown by subsequent physical diagnosis and calculated back to the time when the biochemical pregnancy test was made.

2. *A Correct Negative.*—This is a test performed on the urine of a woman who was found subsequently to menstruate at her next two regular periods.

3. *A False Positive.*—This is a test with a positive result performed on the urine of a woman who menstruated for the next two regular periods, and who was shown by subsequent physical examination not to be pregnant.

4. *A False Negative.*—This is a test with a negative result run on the urine of a woman who failed to menstruate at the next two regular periods and who subsequently proved to be pregnant by physical examination, and calculated back to the time when a biochemical test was run.

\*With the technical assistance of A. Olen, M.D., B. Dusza, B.S., R. Meyer, M.S., R. Smith, M.S., and E. Deran, B.S.

### General Procedure

Urine samples were uniformly collected from all subjects immediately upon arising. In cases where bleeding or spotting interfered with the obtaining of a clear specimen, a suitable catheterization technique was employed. Each sample was analyzed by the Richardson technique within four hours of the time of collection. In a few of the instances which are noted in the charts the urine sample was allowed to stand at room temperature for 24 to 48 hours and in other instances, also noted in the chart, the samples were stored in 5° C. for from 24 to 48 hours. The test reagents were of two origins: (1) We prepared reagents in our Laboratory according to the directions in Procedure A of Richardson's original article with the exception that 95 per cent instead of 70 per cent alcohol was used. (2) Most of the tests were run with reagents supplied in kit form by the LaMotte Chemical Products Co. of Baltimore, Md. The technique was precisely that recommended, by both Richardson in his original article and LaMotte who supply directions with their test kit. In those instances where deviations in the original technique were made for purposes of experimentation these deviations are clearly pointed out in the body of the text.

#### *Reagents and Procedure of the Test as Performed by Us.—*

##### *Reagents\*:*

- I. 0.5 normal sodium hydroxide.
- II. Chloroform, U.S.P. This reagent should be washed with distilled water at least four times.
- III. 0.5 normal sulfuric acid.
- IV. Freshly prepared, saturated solution of 2,4-dinitrophenylhydrazine dissolved in 95 per cent ethyl alcohol.

##### *Procedure:*

Since the extraction tubes described by Richardson were used in each of our tests, the procedure will be given, using them.

1. Place urine into the outer tube of the extraction tubes up to the lower mark. This represents 2 ml. urine.
2. Add 2 drops of Reagent I from a calibrated  $\frac{1}{2}$  ml. dropper held strictly vertically. Mix well.
3. Add Reagent II until the liquid level reaches the upper mark on the tube. This represents an addition of 2 ml. chloroform.
4. Close the tube with a clean rubber stopper and shake vigorously for 30 seconds.
5. Remove stopper and allow the tube to stand undisturbed until a clear separation has taken place. This may take as much as five minutes.
6. Carefully insert inner extraction tube and carefully allow upper layer to enter the hole in the inner tube. Be very careful not to allow any of the chloroform or of the sediment which may be found between the two layers to enter the inner tube.
7. Separate the tubes. Discard the fluid in the outer tube.
8. Add 4 drops of Reagent III from a calibrated  $\frac{1}{2}$  ml. dropper held strictly vertically.
9. Mix well.
10. Add 5 drops of Reagent IV. Mix well. Allow to stand 10 minutes.
11. Add 2 ml. Reagent I. Use the calibrated  $\frac{1}{2}$  ml. dropper in step 2 but be sure to add 4 such dropperfuls. Note that all samples turn brown at this stage.
12. Mix well and allow to stand 2 minutes.
13. A brown or dark amber color remaining after 2 minutes indicates a positive test. A colorless solution or a pale tan is a negative test.

\*The reagents and extraction tubes for this test are available in kit form from the LaMotte Chemical Products Co., Towson 4, Baltimore, Md.

14. It is presumed that a water blank, as a negative control, has been carried out on the reagents, by running the entire test on distilled water.

15. A positive control is also essential. It is performed by using 2 ml. of a solution of 1 drop acetone in 50 ml. water and carrying out steps 1, 2, 8, 9, 10, 11, 12 only of the procedure.

### I. Factors Pertaining to the Subject

#### A. *The Subject Must Be a Woman Capable of Being Pregnant.*—

Four groups of subjects not falling within this category were evaluated and compared with the normal functional female. The results are as follows:

1. *Males:* Table I indicates results when the Richardson pregnancy test was performed on the urine of males.

TABLE I. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES FROM MALES

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
40	27	13

2. *Preadolescent females:* Table II presents the results obtained when the Richardson pregnancy test was performed on urine obtained from preadolescent girls.

TABLE II. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES FROM GIRLS AGED 2 TO 7 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
18	11	7

3. *Postclimacteric women:* Table III indicates results obtained when the Richardson pregnancy test was performed on urine obtained from postclimacteric women.

TABLE III. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES FROM WOMEN AGED 63 TO 81 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
23	16	7

4. *Hysterectomized women:* Table IV indicates the results obtained when the Richardson pregnancy test was performed on urine obtained from hysterectomized women.

TABLE IV. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES FROM HYSTERECTOMIZED WOMEN AGED 32 TO 41 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
26	16	10

5. *Normally functioning women:* Table V indicates results obtained when the Richardson pregnancy test was performed on normal, carefully controlled pregnant women in the first trimester of pregnancy.

TABLE V. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES OF NORMALLY PREGNANT WOMEN IN THE FIRST TRIMESTER OF PREGNANCY, AGE RANGE 18 TO 34 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
650	657	2

6. *Normal, carefully controlled nonpregnant women:* Table VI indicates results obtained when the Richardson pregnancy test was performed on such woman who were shown to be nonpregnant by the Aschheim-Zondek test and who menstruated at their next two regular periods.

TABLE VI. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES OF NORMAL NONPREGNANT WOMEN AGED 18 TO 34 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
316	3	313

*B. Drugs of Various Origins Must Be Strictly Avoided.—*

The following series of experiments were conducted upon known nonpregnant women who had consistently given negative results with the Richardson pregnancy test. In each instance the woman was given the drugs under study and samples of urine were collected at the time intervals indicated in the tables, and the pregnancy test performed. The results obtained under these conditions are presented in the following tables:

Table VII indicates the results obtained when the urine of a nonpregnant woman who had been given intramuscular injections of estrone was analyzed by means of the Richardson pregnancy test technique.

TABLE VII. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES OF NON-PREGNANT WOMEN GIVEN INTRAMUSCULAR INJECTIONS OF 2 MG. ESTRONE; SAMPLE COLLECTED AFTER 24 HOURS. AGES OF SUBJECTS 23 TO 34 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
45	45	0

Table VIII presents the results obtained when the urine of nonpregnant women who had been given the sedatives indicated in the table was subsequently analyzed by means of the Richardson pregnancy test technique.

TABLE VIII. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES OF NON-PREGNANT WOMEN EACH GIVEN 2 TABLETS OF 60 MG. PHENOBARBITAL 6 HOURS APART; URINE COLLECTED 24 HOURS AFTER SECOND DOSE. AGES OF SUBJECTS 22 TO 34 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
64	47	17

Table IX indicates the results obtained when the urine of nonpregnant women who had been given analgesics was analyzed by means of the Richardson pregnancy test technique.

TABLE IX. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES OF NON-PREGNANT WOMEN, EACH GIVEN 2 TABLETS OF THE NATIONAL FORMULARY APC PREPARATION; URINE COLLECTED AFTER 24 HOURS. AGES OF SUBJECTS 21 TO 36 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
57	45	12

Table X presents the results obtained when the urine of a nonpregnant woman who had been given sulfonamides was analyzed by means of the Richardson pregnancy test technique.



TABLE X. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES OF NON-PREGNANT WOMEN EACH HAVING UNDERGONE THERAPY WITH TRICOMBISUL; URINE COLLECTED 24 HOURS AFTER LAST DOSE. AGES RANGED FROM 18 TO 39 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
23	2	21

Table XI presents the results obtained when the urine of nonpregnant women who had been given antibiotics was analyzed by means of the Richardson pregnancy test technique.

TABLE XI. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES OF NON-PREGNANT WOMEN WHO HAD BEEN GIVEN INTRAMUSCULAR INJECTIONS OF 600,000 UNITS OF PROCAINE PENICILLIN; URINE COLLECTED 24 HOURS AFTER INJECTION. AGES RANGED FROM 19 TO 37 YEARS

NO. OF SUBJECTS	POSITIVE TESTS	NEGATIVE TESTS
23	1	22

All samples of urine obtained from pregnant women treated with any of the above drugs were found to be positive in each instance.

*C. The Urine To Be Tested Must Be Negative With Respect to Reducing Agents and Ketone Bodies.—*

In this series of tests the urine of known nonpregnant women which contained either sugar and/or ketone bodies was analyzed by the Richardson technique and the following results were found:

Table XII indicates the results of this portion of the study.

TABLE XII. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON NONPREGNANT WOMEN WHOSE URINE SHOWED SUGAR AND/OR KETONE BODIES

NO. OF SUBJECTS	REDUCING SUGAR	KETONE BODIES	POSITIVE TESTS	NEGATIVE TESTS
14	Present	Absent	12	2
16	Present	Present	16	0
9	Absent	Present	8	1

## II. Factors Pertaining to the Reagents

It is to be assumed that the reagents used for the test are of proper identity and of proper strength; beyond this, however, we must be certain that there are no extraneous aldehyde or ketone groups in any of the reagents since it is the carbonyl group specifically which forms the basis of the coupling reaction between the 2,4-dinitrophenylhydrazine and the free estrone which is tested for in the Richardson technique. It is a simple matter to determine the complete freedom from such extraneous carbonyl-containing compounds by running the test on distilled water instead of a sample of urine. Under these circumstances the test must be negative as indicated by a *prompt* fading of the brown color which always results when an excess of sodium hydroxide is added as the final step in the procedure. If this procedure on distilled water fails to produce an absolutely negative test, one or more of the reagents must be contaminated and cannot be used for the proper carrying out of the Richardson technique. We have found that there seemed to be three sources of extraneous carbonyl compounds:

*A. The alcohol used in making up the dinitrophenylhydrazine reagent:* Certain brands of denatured ethyl alcohol contain carbonyl groups as the denaturant. Such an alcohol is obviously unsuitable. There are of course methods of removing such adulterants, but they are beyond the scope of this paper.

*B. The chloroform used for extracting the alkalinized urine:* We have found that there are occasional samples of chloroform which produce a false positive reaction when the technique is performed on distilled water. These abnormally reacting samples of chloroform have been found irrespective of manufacturers' source or grade of purity. We have noted that certain technical grades of chloroform give a false positive reaction, while others are perfectly suitable. By the same token we have found certain "chemically pure" samples of chloroform to give a false positive reaction while other samples are perfectly acceptable. Those samples of chloroform which give a false positive reaction are easily purified by the simple expedient of shaking the chloroform thoroughly with several changes of distilled water. Under usual conditions three such water extractions produce a satisfactory product.

*C. The dinitrophenylhydrazine reagent:* Freshly prepared solutions of dinitrophenylhydrazine give a perfectly negative test when performed with distilled water; if, however, the alcoholic dinitrophenylhydrazine solution is allowed to stand for an appreciable length of time, there is an oxidation of the alcohol by the dinitrophenylhydrazine with the resulting false positive test. Under usual laboratory conditions this oxidation reaction occurs in from 6 to 10 hours. We believe it to be of utmost importance not to use an alcoholic solution of dinitrophenylhydrazine which is older than 6 hours.

### III. Factors Pertaining to Technique

#### *A. A Sample To Be Extracted With Chloroform Must Be Alkaline.—*

According to the original Richardson article, the purpose of this extraction technique is to separate the sodium salt of estrone which is water soluble from the other water-insoluble sterol derivatives. If the urine is not alkalinized and the estrone is not converted into sodium estronate, then such estrone as may be present will most likely be dissolved at the chloroform layer with the result that the test is likely to be falsely negative. The best pH range seems to be from 11 to 12. This is normally achieved by adding the recommended 2 drops of NaOH solution in Richardson's directions.

#### *B. There Must Be a Sharp Separation of Aqueous From Nonaqueous Layers During the Extraction Procedure.—*

It frequently happens that there is a milky layer between a clear aqueous and clear chloroform layer. This milky layer consists of a suspension of very fine droplets of chloroform and of precipitated proteins. Neither of these two extraneous materials must be allowed in the reacting mixture. Since it is the function of the chloroform to extract among other things progesterone, and since progesterone gives a positive reaction in the Richardson technique, no amount of the chloroform that is used to extract the urine under test is tolerable. It is for this reason also that Richardson correctly frowned upon the use of a separatory funnel for the extraction technique. With that technique it is virtually impossible to prevent the ingress of some minute amount of chloroform into the reaction mixture.

#### *C. The Extracted Sample Must Be Acidic Before the Coupling Reagent Is Added.—*

There are two reasons for this:

1. An alkaline solution of dinitrophenylhydrazine alcohol causes oxidation reactions to occur, and
2. The anticipated coupling reaction between the free estrone and dinitrophenylhydrazine does not occur in the alkaline pH range. The optimum pH seems to be 3 to 4. This is achieved when 4 drops of 0.5 N sulfuric acid is added as recommended in the directions.

*D. The Coupling Reaction Requires at Least 7 Minutes for a Reliable Test To Be Achieved.—*

Table XIII illustrates the importance of the coupling time by showing the results obtained when urine from known pregnant females is made to undergo the coupling reaction for the indicated various lengths of time.

TABLE XIII. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES OF PREGNANT WOMEN WHEN THE COUPLING TIME WAS VARIED

NO. OF SUBJECTS	COUPLING TIME	POSITIVE TESTS	NEGATIVE TESTS
10	3 min.	1	9
10	4 min.	1	9
10	5 min.	4	6
10	6 min.	7	3
10	7 min.	9	1
10	8 min.	10	0
10	9 min.	10	0
10	10 min.	10	0
10	15 min.	10	0

*E. The Solution Must Be Strongly Alkalinized at the Final Stage.—*

The development of the typical brown color is achieved only when the coupled product is strongly alkalinized. Richardson's original technique requires the addition of 2 c.c. of 0.5 N sodium hydroxide. The following table presents the results obtained when the indicated varying amounts of sodium hydroxide are added in the final stage of the Richardson technique.

TABLE XIV. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON THE URINES OF PREGNANT WOMEN WHEN THE FINAL ALKALI VOLUME WAS VARIED

NO. OF SUBJECTS	C.C. OF 0.5 N NaOH	POSITIVE TESTS	NEGATIVE TESTS
10	0.25	0	10
10	0.50	0	10
10	0.75	0	10
10	1.00	3	7
10	1.25	7	3
10	1.50	9	1
10	1.75	10	0
10	2.00	10	0

*F. A Control Test Run on Distilled Water, 25 c.c. of Which Contains One Drop of Acetone, U.S.P., Must Be Negative When Run Through the Whole Procedure, but Positive if the Extraction Technique Is Omitted.—*

This type of check on the entire procedure is of value because:

1. It gives the novice an idea of the kind of brown color to be expected.
2. It tests the effectiveness of the extraction procedure.
3. It gives the novice a clear idea of what a negative test should be like.

TABLE XV. RESULTS OF THE RICHARDSON PREGNANCY TEST PERFORMED ON URINES WHICH HAD BEEN STORED

NO. OF SUBJECTS	PREGNANT OR NONPREGNANT	TIME AFTER COLLECTION	TEMPERATURE	POSITIVE TESTS	NEGATIVE TESTS
10	Nonpregnant	12 hr.	room	5	5
10	Pregnant	12 hr.	room	10	0
10	Pregnant	24 hr.	room	10	0
10	Nonpregnant	24 hr.	room	7	3
10	Pregnant	48 hr.	room	10	0
10	Nonpregnant	48 hr.	room	9	1
10	Pregnant	24 hr.	5° C.	10	0
10	Nonpregnant	24 hr.	5° C.	0	10
10	Pregnant	48 hr.	5° C.	10	0
10	Nonpregnant	48 hr.	5° C.	1	9

#### IV. Factors Pertaining to the Sample

We have investigated the effects of storing the sample at room temperature and at refrigerator temperature (5° C.) for 24 and 48 hours; the results are given in Table XV.

We have further investigated the effect of blood in the sample. In each case the test was positive, indicating that such a sample is unsuitable for the diagnosis of pregnancy. The effect of adding preservatives such as iodoacetic acid, thymol, oxalic acid, sodium fluoride, and toluene gave such erratic results that we are convinced of the unsuitability of such preserved urine for a proper evaluation of pregnancy by means of the Richardson pregnancy test.

#### Conclusions and Comments

The critical study of the Richardson pregnancy test as reported in this paper points out clearly the usefulness of the technique when certain well-defined conditions are adhered to. These conditions are:

##### *I. Factors Pertaining to the Subject.—*

A. The subject must be a woman functionally capable of being pregnant. This eliminates males, and pre- and postmenstrual, as well as hysterectomized, females.

B. Drugs of various origins, particularly hormones, sedatives, analgesics, and certain sulfonamides must be assured to be absent.

C. The urine must be negative with respect to ketone bodies.

##### *II. Factors Pertaining to the Reagents.—*

A. They must be fresh and uncontaminated.

B. Dinitrophenylhydrazine must be no more than six hours old. The alcohol solvent must be carbonyl-group free.

##### *III. Factors Pertaining to Technique.—*

A. The sample extracted with chloroform must be alkaline.

B. The separation of aqueous from nonaqueous layer must be sharp.

C. The sample must be acidic before the coupling reagent is added.

D. The reaction must be allowed to proceed for at least 10 minutes.

E. The solution must be strongly alkalinized at the final stage.

F. The water blank must be negative.

G. A dilute acetone control must be positive.

##### *IV. Factors Pertaining to the Sample.—*

The sample must be fresh and no preservatives may be present.

When these precautions are all adhered to, we find the Richardson pregnancy test to be a valuable procedure to diagnose early pregnancy with a high degree of accuracy. A careful analysis of reports critical of the procedure have shown that they (a) attempt to use the technique under conditions for which the test was not designed and (b) fail to follow the simple but specific directions.

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## COARCTATION OF THE AORTA AND PREGNANCY\*

### Report of Three Cases

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**R**ECENT advances in cardiovascular surgery have altered the prognosis in patients suffering from congenital cardiac lesions. One of the most amenable of these lesions to surgery is coarctation of the aorta. This condition is infrequently complicated by pregnancy. Previously, the management of these cases was either by therapeutic abortion in the early months, or, when near term, by delivery by cesarean section and immediate tubal ligation. Although no writer has advocated vaginal delivery, Edmund Novak<sup>1</sup> in 1943 reported a case in which vaginal delivery was anticipated and successfully managed. He urged that all cases of coarctation in pregnancy be reported so that the management of these cases could be determined on a well-authenticated basis. In view of the surgical success with this cardiovascular malformation, the request is more cogent. Many of the patients successfully operated upon can assume normal lives. Their pregnancies should not be routinely aborted or terminated by cesarean section and sterilization. The need for re-evaluation of the method of delivery in these rare cases is self-evident. To this end, we report three cases of coarctation of the aorta complicated by pregnancy. Two of these patients have been operated on for the coarctation, one prior to and the other subsequent to vaginal delivery.

HOSPITAL No. 84418.—The diagnosis of coarctation of the aorta was made in 1948 when the patient was 23 years old and was being investigated for hypertension. The blood pressure was 180/100 in her arms, while neither lower extremity had a tibial or a femoral pulse. The chest x-ray revealed generalized cardiac enlargement with left ventricular preponderance, the aortic shadow was widened but the knob was not well visualized; there was no notching of the ribs. The electrocardiogram reported left axis deviation. The only symptom this patient ever had referable to her cardiovascular condition was occasional precordial distress. This was also true during her pregnancy, for which as a 25-year-old gravida i she had an estimated date of confinement of July 22, 1950. One day before term she went into labor spontaneously and, after an easy labor of five hours, she was delivered of a healthy, 2,835 gram female infant under nitrous oxide and ether anesthesia by episiotomy and low forceps. Sedation during labor consisted of 300 mg. of meperidine hydrochloride and 180 mg. of pentobarbital sodium. The highest blood pressure recorded at any time was 210/100.

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Prophylactic penicillin was administered during the labor and during an uneventful puerperium. This patient had a subsequent successful repair of the coarctation of the aorta.

HOSPITAL No. 59059.—In this patient the diagnosis of congenital heart disease with coarctation of the aorta was made in 1943. At this time she was hospitalized with a diagnosis of subacute bacterial endocarditis. She was 17 years old and was one of the first subacute bacterial endocarditis patients to be successfully treated with penicillin. In spite of this, there were residual complications from emboli, namely, blindness in the right eye and epileptiform seizures which required daily anticonvulsive medication. Chest x-rays in 1943 and 1950 revealed cardiac enlargement and notching of the ribs. On Feb. 2, 1950, this patient was admitted as a 25-year-old gravida i with an estimated date of confinement of March 25, 1950. Cardiovascular studies showed her heart to be well compensated. She was confined to bed rest in the hospital. During that time her blood pressure averaged 160/100. Twenty days from term the membranes ruptured spontaneously and two hours later labor was induced by intravenous Pitocin. After a labor of less than three hours she was delivered of a healthy, 3,188 gram female infant under nitrous oxide and ether anesthesia by episiotomy and low forceps. Sedation during labor consisted of 200 mg. meperidine hydrochloride and 180 mg. pentobarbital sodium. A slight postpartum hemorrhage immediately after delivery was controlled by plain gauze packing of the uterus. Prophylactic penicillin was administered during labor and during an uneventful puerperium.

HOSPITAL No. 108808.—When 16 years old this patient had an exploratory thoracotomy on the University surgical service with the preoperative diagnosis of congenital heart disease and coarctation of the aorta. At operation there were only two vessels coming from the aortic arch and both coursed to the left, one transversing to the left side of the neck and the other to the left arm. The aortic arch ended in a calcified knob and the remaining portion of the thoracic aorta was completely atretic. Surgical repair was not possible.

On Aug. 15, 1952, this patient presented herself in the prenatal clinic as a 19-year-old gravida ii, para 0, with an estimated date of confinement of Nov. 8, 1952. Her previous pregnancy ended in a spontaneous abortion at 3 months.

She was hospitalized for an evaluation of her cardiovascular condition and also to limit her physical activity. Her symptoms before and during the pregnancy consisted of varying degrees of headache, precordial pain, dyspnea, generalized weakness, and occasional ankle edema. Physical examination revealed blood pressures of 280/130 in the left arm and 135/110 in the right arm. The heart tones were of normal rhythm with a loud systolic murmur heard over the entire precordium, accompanied by a thrill at the left sternal border. The uterus was enlarged to the size of a 6 months' gestation, with normal fetal heart tones. There was no ankle edema. Renal function tests were normal and there was no albuminuria. On chest x-ray there was noted generalized cardiac enlargement, absence of the aortic knob, and notching of the ribs in the left hemithorax. An electrocardiogram showed left ventricular hypertrophy and strain.

For the remainder of the pregnancy she was kept in the hospital on bed rest, a salt-free diet, and light sedation. Repeated urine and blood studies were negative. The patient did not become toxic nor the heart decompensated; however, she became increasingly more uncomfortable with her usual complaints of headache, precordial pain, dyspnea, and generalized weakness and discomfort. These symptoms were controlled with codeine, analgesics, and occasionally with oxygen.

There was a difference of opinion as to the method of delivery. Some favored cesarean section and tubal ligation as soon as fetal viability was achieved; however, the prevailing opinion was that she was too poor an operative risk for this and that a vaginal delivery be anticipated, with immediate postpartum Pomeroy tubal ligation, if her condition permitted. Prophylactic penicillin was to be used throughout the labor and postpartum period. Meperidine hydrochloride only was to be used for sedation during the

labor; delivery and ligation were to be done under pudendal block and local infiltration of 1 per cent procaine. The second stage of labor was to be shortened as soon as possible by delivery with low forceps.

Near term the patient had increasing lower abdominal discomfort. Vaginal examination revealed a well-engaged fetal head in a pelvis that was adequate. The cervix was effaced and two fingers dilated. On Oct. 4, 1952, labor was induced by surgical rupture of the membranes. Labor, delivery, and immediate postpartum ligation were managed successfully as planned. During her six and one-half hour labor she received 200 mg. of meperidine hydrochloride. The blood pressure in her arms did not exceed that previously recorded. The baby, who weighed 5 pounds, 15 ounces, at birth, and the mother did well in the postpartum period and they left the hospital on the tenth postpartum day.

### Conclusion

Three cases of coarctation of the aorta and pregnancy with successful management of vaginal delivery have been presented.

We feel that the method of delivery and the question of sterilization should take into consideration the prognosis offered by the advances in cardiovascular surgery.

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## Department of Case Reports

### New Instruments, Etc.

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#### **RUPTURED SPLEEN SIMULATING ECTOPIC PREGNANCY\***

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THE diagnosis of the source of an acute intra-abdominal hemorrhage, in a woman of the childbearing age, particularly with a history of amenorrhea, is difficult to make. The complexity of the problem is indicated by a 20 per cent incidence of incorrect preoperative diagnosis of ruptured tubal pregnancy,<sup>1</sup> the most common cause of such bleeding. The diagnosis is further confused by the similar picture produced by various causes of intra-abdominal bleeding in nonpregnant women. Free blood in the peritoneal cavity may originate from intraperitoneal or retroperitoneal sources. Bleeding from a ruptured adnexal varix or ruptured ectopic pregnancy is an example of the former, while retroperitoneal bleeding with secondary rupture into the free peritoneal cavity may occur following such accidents as rupture of an aneurysm of a renal artery. Table I lists the various reported causes of intra-abdominal hemorrhage.<sup>2-6</sup> The case we are presenting herewith is unusual because it closely simulates an ectopic pregnancy. This resemblance was due to the preponderance of pelvic symptoms associated with two months' amenorrhea in a patient with an intra-abdominal hemorrhage secondary to a rupture of the spleen.

#### **Case History**

E. M., a 37-year-old Negro woman, entered Cook County Hospital on May 16, 1953, complaining of pain in the lower abdomen and weakness of one day's duration. One week prior to admission she had a sharp periumbilical pain which was followed by an urge to stool. On her way to the bathroom she fainted and fell to the floor. She felt better upon regaining consciousness and did not seek medical aid. During the ensuing week she was able to carry on her chores but noted that her abdomen was becoming distended and tender to touch. Although this patient was born in Alabama, she had lived in Chicago for the past seven years. She denied any serious illnesses, had had no previous surgical procedures, and did not use alcohol, tobacco, or narcotics. The patient had never been pregnant nor had she missed any menstrual periods until this time. Her last normal menstrual period was Jan. 28, 1953, with no spotting or bleeding since that date. She gave no history of menopausal symptoms.

\*Presented at a meeting of the Chicago Gynecological Society, Nov. 20, 1953.



Physical examination revealed an acutely ill Negro woman of 37 with marked pallor of the conjunctiva and mucous membranes. There were no signs of external trauma or bleeding. Her blood pressure was 116/70, pulse rate 104, respirations 26 per minute, temperature 101° F., and hemoglobin 70 per cent (Tallqvist). The positive physical findings were confined to the abdomen which was moderately distended, somewhat more below the umbilicus. The tenderness was greatest in the left lower quadrant. The liver, kidneys, and spleen were not palpable nor were there any abdominal masses.

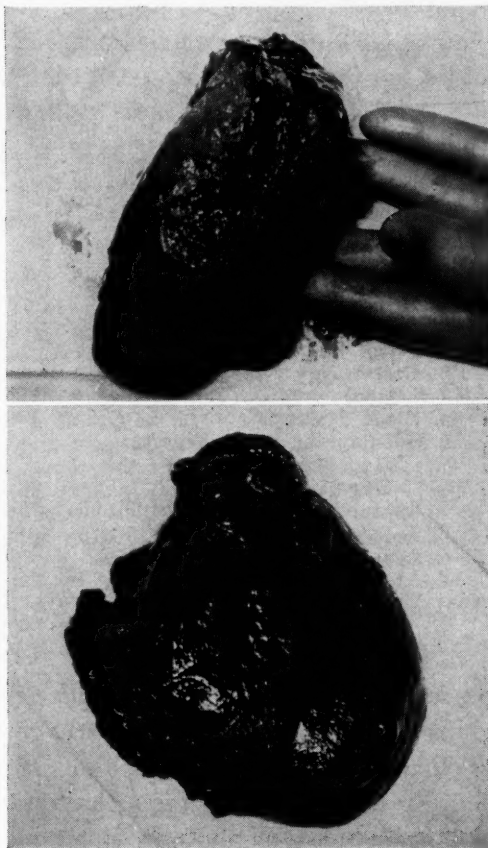


Fig. 1.

Bowel sounds were present but hypoactive. Pelvic examination revealed fullness in the cul-de-sac and lateral vaginal fornices; a firm, congested nulliparous cervix; and a normal-sized corpus uteri. No adnexal masses were felt. Motion of the cervix provoked marked pain, particularly on the left side. Colpocentesis was performed and 10 c.c. of non-clotting blood was aspirated. In spite of supportive therapy, the patient seemed to be losing ground and a laparotomy was deemed necessary. At surgery, the peritoneal cavity was found to contain approximately 1,200 c.c. of liquid and clotted blood. The uterus was inspected and found to be normal. The adnexa exhibited evidence of chronic salpingitis but no pregnancy. Exploration of the upper abdomen revealed a small, firm liver with hobnail irregularities on its surface, and numerous perihepatic adhesions. The spleen was large and friable (400 grams). It was freed from its surrounding adhesions and brought into full view, exposing a large rupture on the diaphragmatic surface (Fig. 1). Splenectomy was then performed. Exploration of the remaining abdominal contents revealed them to be normal. The postoperative course was uneventful and the patient was discharged on the fourteenth postoperative day in good condition.

TABLE I. LISTING OF VARIOUS REPORTED CAUSES OF INTRA-ABDOMINAL HEMORRHAGE

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<i>Ruptured Viscera Such as:</i>	
a.	Liver
b.	Spleen
c.	Uterus and adnexa
d.	Ectopic pregnancy
	Tubal
	Abdominal
e.	Stomach
	Peptic ulcer
f.	Ovary
	1. Corpus luteum
	2. Ovarian neoplasm
	3. Chocolate cyst
<i>Ruptured Aneurysm of Such Arteries as:</i>	
a.	Aorta
b.	Renal
c.	Hepatic
d.	Splenic
e.	Celiac
f.	External iliac
g.	Hemorrhoidal
<i>Ruptured Varices of:</i>	
a.	Broad ligament
b.	Uterovarian veins
<i>Miscellaneous:</i>	
a.	Blood dyscrasia
b.	Spontaneous hemorrhage in
	Hypovitaminosis C or
	Hypervitaminosis A
c.	Ruptured vessel of uterine fibroma
d.	Rupture of renal lipoma
e.	Acute mesenteric thrombosis
f.	Acute pancreatitis

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### Comment

Diagnosis of rupture of the spleen depends primarily on the presence of the various clinical signs of intra-abdominal hemorrhage since there are few known laboratory or investigative procedures that apply directly to the spleen. The usual clinical signs and symptoms characteristic of a ruptured spleen are: palpable splenic mass or dullness upon percussion in the left flank, shifting dullness in the right flank, shoulder pain, thoracolumbar respiratory immobility, spontaneous or induced pain, particularly in the left upper quadrant, and abdominal distention or rigidity.<sup>7, 8, 9, 12</sup> The roentgenologic findings of increased density in the left upper quadrant of the abdomen, obliteration of the splenic shadow, elevation of the left diaphragm and displacement of the stomach toward the right side, with evidence of free fluid between the loops of intestine offer one of the most useful diagnostic aids.<sup>6</sup>

Spontaneous rupture of a normal spleen is so rare that many authorities doubt its existence.<sup>10</sup> Spontaneous rupture of a diseased spleen may occur in pregnancy and puerperal infection or in typhoid fever and malaria.<sup>9, 11, 12</sup> It has also been reported to occur in infectious mononucleosis, sarcoidosis, and hepatitis.<sup>12</sup> Traumatic rupture of a diseased spleen, on the other hand, may be caused by the force exerted by such physiological acts as coughing or vomiting; by contrecoup force, or by direct violence. Thus, history of

trauma, even trivial, is important, and, in obscure abdominal emergencies, rupture of the spleen must be considered in the differential diagnosis.<sup>10</sup> Colpocentesis may be of considerable aid in establishing the presence of intra-abdominal bleeding from any source in women.

### Summary

1. A case has been reported of massive intra-abdominal hemorrhage from a ruptured spleen clinically simulating a ruptured ectopic pregnancy.

2. It is suggested that colpocentesis be utilized as an aid in the diagnosis of intra-abdominal bleeding from any source.

*Addendum.*—Barnett<sup>13</sup> reports a rupture of the spleen in a 37 weeks' gestation, reviews the literature, and adds 28 additional cases that occurred during pregnancy, labor, or the puerperium.

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## MASSIVE INTRA-ABDOMINAL HEMORRHAGE FROM UTERO-OVARIAN VEIN RUPTURE FOLLOWING DELIVERY

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THIS case seems noteworthy in that rupture of the utero-ovarian veins associated with pregnancy is a relatively rare complication and one that frequently ends in a fatality. Diagnosis of the condition is extremely difficult unless one is on the alert and realizes that the utero-ovarian veins may rupture spontaneously during pregnancy or following uncomplicated or nontraumatic labors. Very little or no attention at all has been given to this very serious condition in the standard textbooks of obstetrics.

A review of the literature by Hodgkinson and Christensen<sup>1</sup> in 1950 revealed seventy-two cases with a mortality of 49.3 per cent. They added three case reports of their own. In two of these the diagnosis was not made until autopsy was performed. In the third case hemorrhage did not occur until the fourteenth postpartum day and was limited to the retroperitoneal space. Laparotomy subsequently revealed the condition and the patient made an uneventful recovery.

Because of the rare occurrence of this condition and particularly because of its association as a postpartum complication, we wish to add another interesting case.

M. W. (Case No. 75664), a 35-year-old gravida vi, para v, was admitted to Barberton Citizens Hospital, Barberton, Ohio, on Dec. 24, 1952, at 10 A.M. The expected date of confinement was Dec. 28, 1952. The patient stated that labor began four hours before admission. Initial examination revealed the cervix to be 4 cm. dilated and to be well effaced. Two hours later the patient was delivered of a living male infant that weighed 8 pounds. The delivery was spontaneous and uneventful under light ether anesthesia with the aid of a small midline episiotomy. The third stage was uncomplicated and the placenta was complete. Blood loss was minimal. She appeared in good condition immediately following delivery and the attending physician left the hospital. About one hour later he was summoned and returned to find the patient in deep shock. The blood pressure was imperceptible. The pulse was barely palpable at 120 per minute. The uterus was palpable and described as firm. Vaginal bleeding was not excessive. In spite of the usual combative measures for shock, including plasma, 1,000 c.c. of whole blood, and the oxygen tent, her condition did not improve to any great extent. A tentative diagnosis of rupture of the uterus was made and a consultant was called. Upon his arrival, the patient was moribund. The pulse was weak and rapid and blood pressure was unobtainable. The abdomen was extremely tender and moderately distended. Marked dullness was elicited in both flanks as well as a shifting dullness and a fluid wave. The attending physician stated that earlier the patient had complained of marked shoulder pain and abdominal discomfort. A diagnosis of intraperitoneal hemorrhage, probably due to rupture of the uterus, was made and laparotomy was advised. It was necessary to defer the operation for two hours awaiting



the arrival of four pints of blood from Akron, Ohio. At 8 P.M. (eight hours after delivery), the patient was removed from the oxygen tent and taken to surgery where a transfusion was started in both arms. Under local infiltration with 1 per cent procaine, supplemented by a light ether anesthesia, a low midline incision was made. The peritoneal cavity was opened and a large quantity of free and clotted blood was found, filling the entire abdomen. This was estimated at 3,000 c.c. There were several clots of blood underneath the liver measuring 7 by 9 inches in diameter. After the abdominal cavity was evacuated of this blood, the uterus and adnexal organs were brought out through the incisional opening. A large hematoma, measuring 10 by 12 cm., was present between the leaves of the left broad ligament near the left cornu of the uterus. Further inspection of this area revealed a site of rupture of the peritoneum over the site of hematoma. Digital exploration of this "rent" led us to believe that it communicated with the uterine cavity. However, post-operative examination of the uterus proved this to be false. The hemorrhagic process had distorted and damaged the broad ligament and infundibulopelvic ligament, so it was decided to do a supracervical hysterectomy and left salpingo-oophorectomy. Because of the hematoma, considerable peritonization was necessary on the left side. The abdomen was closed in layers. The patient recovered from the anesthesia immediately following closure. She seemed much improved, the pulse was slower, the blood pressure was 104/70 and soon was 120/80. On regaining consciousness, her first remark was that she felt much better.

The postoperative course was entirely uneventful. She received two additional units of whole blood and was discharged from the hospital eleven days after the operation.

Gross pathological examination of the uterus revealed an essentially normal post-partum uterus. In the mesosalpinx and the mesovarium there was a large amount of infiltrating fresh hemorrhage.

This patient received a total of 4,000 c.c. of blood during her hospital stay. We attribute her recovery from this complication to prompt surgical intervention and the replacement of blood loss. It is speculated that the hematoma was the result of the rupture of a vessel between the leaves of the broad ligament in the proximity of the left cornu of the uterus which subsequently was followed by a rupture of the hematoma with extensive intra-peritoneal hemorrhage. However, pathological examination did not disclose the precise point of the break in the vessel.

An analysis of a number of cases of utero-ovarian vein rupture reported in the literature showed that this complication occurred more frequently during the prenatal period as early as ten weeks' gestation, and as late as twenty-one days post partum. In 1931, Falk<sup>2</sup> reviewed twelve cases, nine of which represented autopsy records. In all of these, the complication occurred in the prenatal period. The causative factor in the two cases reported by D'Errico<sup>3</sup> in 1933 was not determined. One patient died and one survived. Both occurred in the prenatal period. In Miller's<sup>4</sup> case, reported in 1928, the patient was operated upon under a mistaken diagnosis of separation of the normally implanted placenta and the patient made an uneventful recovery. Miller reviewed the literature and found that only in a few instances had the patient survived the catastrophe.

The causative factor or factors that result in utero-ovarian vein rupture in pregnancy are still obscure. It is generally believed that trauma does not play a role in this condition. That the venous load during pregnancy is greatly increased is a well-known fact. This is evidenced by the frequent observation of pelvic varicosities during cesarean sections.

Despite the fact that in most cases the diagnosis is made after laparotomy or autopsy, its recognition is totally dependent upon the symptoms elicited and upon the awareness of the physician that such a catastrophe can and does occur in uncomplicated pregnancies as well as following normal deliveries. The symptoms most suggestive are abdominal pain of various degrees and increasing sensitiveness of the abdomen, depending upon whether the hemorrhage produced is retroperitoneal, intraperitoneal, or a combination of the two. The differential diagnosis is variable depending upon when the condition occurs. Rupture of the uterus, either complete or incomplete, and abruptio placentae are the more frequent diagnoses made if the condition occurs in the prenatal period, whereas if it occurs in the puerperium the most likely diagnosis is that of rupture of the uterus, which of course demands immediate laparotomy, the arrest of the hemorrhage, and replacement of blood loss if one is to achieve a good result.

### Summary

1. A case of massive intra-abdominal hemorrhage resulting from rupture of the utero-ovarian vein in the immediate postpartum period is reported.
2. The survival of the patient was attributed to early surgical intervention.
3. A review of the literature revealed the rarity of this complication and its high mortality.
4. It is felt that the diagnosis of utero-ovarian vein rupture might be made more often if only the possibility of its occurrence were kept in mind.

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## DISSECTING ANEURYSM OF THE ASCENDING AORTA ASSOCIATED WITH PREGNANCY

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**T**HE occurrence of a dissecting aneurysm in a patient under the age of 40 years is a rare finding. The following case history occurring in a white woman, aged 35, six days after delivery, is presented.

### Case Report

This patient was first examined on Aug. 28, 1952. Her past history was negative; there had been no operations or serious illnesses. There were two previous term pregnancies, 14 and 8 years before, the second terminating in a breech delivery. At the initial examination the blood pressure was 130/80, pulse 72, respirations and temperature normal, and weight 137 pounds. The general physical examination was essentially negative except for the presence of varicose veins of both lower extremities.

On pelvic examination a diagnosis was made of an intrauterine pregnancy of 3 months' duration. Pelvic measurements were adequate. The expected date of confinement was estimated to be March 1, 1953.

Examination of the blood revealed a hemoglobin of 92 per cent, and a red blood count of 4.63 million. The Kahn test was negative and the Rh factor negative; her husband was Rh positive. Urinalysis was essentially negative.

The prenatal course was fairly normal. The blood pressure varied between 120/80 and 140/100, the last reading just prior to the onset of labor being 124/90. Repeated urinalyses were consistently normal. There was a weight gain of 20¼ pounds. Rh titers taken during the last trimester did not show the presence of any agglutinating or blocking antibodies.

Labor started spontaneously at 8:00 A.M., Feb. 28, 1953, with slow dilatation of the cervix and irregular pains during the first 12 hours. By 1:38 A.M., March 1, 1953, the cervix was completely dilated and the occiput was presenting low in the pelvis. Delivery of a normal female infant that weighed 7 pounds, 15 ounces, from the left occipitoanterior position was completed by low forceps and episiotomy at 2:10 A.M. Examination of the cord blood revealed a hemoglobin of 140 per cent, red blood count 5.60 million, nucleated red blood cells none, Coombs test negative, Rh factor negative, and blood type O.

The patient made an uneventful recovery with no rise of temperature and was discharged March 5, 1953, on the fourth day post partum. She did not nurse her baby.

At 4:00 P.M., March 6, 1953, while sitting quietly and drinking coffee at home, the patient was seized with a sudden severe, piercing, substernal pain which radiated to both arms and both sides of the neck and was accompanied by faintness and weakness. She immediately went to bed and experienced a restless night not seeking medical advice until the next morning. She was examined at 10:30 A.M., March 7, 1953. At that time the patient was pale, weak, and in partial syncope. Examination of the heart did not show any enlargement; however, over the entire precordium there was a loud blowing systolic murmur followed by a harsh diastolic murmur entirely replacing the heart sounds. The pulse rate was 72, temperature and respirations normal. A tentative diagnosis of mitral stenosis was made with the possibility of an embolism to be considered and the patient was hospitalized as soon as possible.

She was readmitted to the hospital at 12:45 P.M., March 7, and immediately examined. At that time she was lying quietly in bed, manifestly in some, but not severe, discomfort from both the still persistent chest pain and headache. She was alert and cooperative. The temperature was 98.8° F., pulse regular, rate 72, and the blood pressure had risen to 188/88. Thoracic movements were symmetrical and unimpaired. Percussion produced normal resonance throughout the chest; the breath sounds were vesicular and there were no râles. Examination of the heart revealed the remarkably harsh and loud murmurs previously described. No thrill was palpable nor could any friction rub be heard.

Shortly after the examination had been completed she was given codeine sulfate,  $\frac{1}{2}$  grain, for the headache and chest pain. A few minutes later she asked to go to the bathroom and the request had hardly been spoken when she began gasping for breath, became cyanotic, and died, less than two hours after she had entered the hospital.

Autopsy performed by Dr. Joseph Nohlgren on March 9, 1953, revealed the following pertinent findings: The pericardial sac was greatly enlarged and globular in shape. It measured 18 cm. in its greatest transverse diameter and externally had a deep bluish color. When opened it contained approximately 750 c.c. of liquid blood and clots. The heart was not enlarged, measuring 8.5 cm. in its greatest transverse diameter and weighing approximately 350 grams. There was no evidence of myocardial hypertrophy and no intrinsic pathologic changes in the heart were found.

The ascending aorta appeared slightly enlarged outwardly and a mass of clotted blood and fibrin was adherent to the outer surface. A small linear rent in the adventitia was found on the right posterolateral surface a short distance beneath the pericardial reflection. When the aorta was opened a transverse intimal tear measuring 1.5 cm. in length was found slightly more than 1 cm. above the aortic valve cusps. This communicated with a channel of dissection in the media which extended from the aortic ring distally to a point 1 cm. beyond the origin of the left subclavian artery. In places the dissection completely circumscribed the aorta and the blood-filled false channel measured as much as 7 mm. in thickness. There was no extension into the great vessels. The remainder of the aorta showed no gross alteration other than minimal arteriosclerosis limited to scattered subintimal plaques of small size.

Death was attributed to cardiac tamponade due to secondary intrapericardial rupture of a dissecting aneurysm of the aorta.

### Comment

Schnitker and Bayer<sup>1</sup> reported in 1944 a total of 580 cases on record of dissecting aneurysms in all age groups. Of this number 141 patients, or 24.31 per cent, were under the age of 40 years, 92 males and 49 females. Further analysis showed that 24 cases, or 49 per cent, were associated with pregnancy, the majority occurring during the last trimester before the onset of labor. The catastrophe occurred in 2 patients during the postpartum period, their own case 12 days after delivery, and in a case previously reported three weeks after delivery. The present patient adds one more to this postpartum group.

The following conclusions were arrived at by Schnitker and Bayer in their analysis of this series of dissecting aneurysms occurring in patients under the age of 40 years:

1. Hypertension occurred in approximately only one-half of the patients on whom data were available.
2. Trauma was not a significant factor.
3. The underlying lesion appeared to be a degenerative cystic necrosis of the media.



4. In 31.9 per cent a congenital narrowing of the aorta, varying in degree up to extreme stenosis and coarctation, existed.

5. Death occurred in 78 per cent due to secondary rupture into the pericardium.

Recently Weil<sup>2</sup> reported a dissecting aneurysm of the arch of the aorta causing a sudden maternal death due to rupture into the pericardium at the end of the seventh month of pregnancy. In this case an immediate postmortem cesarean section was performed and a live premature infant delivered.

### Summary

An additional case report of a dissecting aneurysm of the ascending aorta with rupture into the pericardial sac in a woman, aged 35 years, occurring six days post partum, is presented.

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## SEVERE HEMORRHAGE AND MATERNAL DEATH ASSOCIATED WITH AMNIOTIC FLUID EMBOLISM\*

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**S**UDDEN maternal death shortly before, during, or after delivery is frequently preceded by shock. The predisposing factors to obstetrical shock may be numerous and not always detectable. One of the unknown factors has been identified and experimentally substantiated by Steiner and Lushbaugh,<sup>1</sup> who first described amniotic fluid embolism.

Since their original communication about 55 cases have been reported in the world literature. In 1941 Steiner and Lushbaugh<sup>1</sup> reported three cases from the Chicago Lying-in Hospital. However, during the past twelve years no maternal death has been attributed to this condition in this same institution.

Recently a patient who succumbed with uncontrollable postpartum hemorrhage was found to have a massive amniotic fluid embolism.

### Case Report

A. W. (No. 410522), a white woman, aged 41 years, was at term in her eighth pregnancy (3 abortions). The pregnancy was uneventful and her blood pressure levels were within normal limits except on two occasions when values of 150/88 and 140/90 were recorded. Proteinuria occurred twice as "slight trace" or "trace."

On the day of admission it was reported that the patient was having painless vaginal bleeding. She was subsequently admitted and though no bleeding was observed at this time, routine blood cross-matching and typing were done.

Three hours after admission a small amount of vaginal bleeding occurred. A sterile vaginal examination was done with fluids and blood in readiness. No cause for the bleeding was detected; the fetal head was above the inlet and since the cervix appeared to be "ripe" and 3 cm. dilated, the membranes were artificially ruptured to induce labor. The fetal heart tones were normal. The patient went into labor two hours later. After less than four hours of labor the uterine contractions became tetanic. Examination revealed that the head was high and no fetal heart tones could be heard. The patient was taken to the delivery room immediately for inhalation anesthesia and vaginal examination. Within a few minutes slight vaginal bleeding occurred and the patient was bearing down involuntarily. The blood pressure was 170/90. Vaginal examination revealed that the head was on the perineum and the cervix completely dilated. The baby was delivered with an episiotomy and low forceps, and appeared to be in poor condition. The placenta showed no evidence of premature separation.

Brisk bleeding from the uterus occurred after the placenta was delivered. The uterus was firm and there were obvious lacerations present in the lower birth canal. While the episiotomy was being repaired, intravenous fluids were administered and whole blood was kept in readiness. Because of the continuous bleeding, the uterus and vagina were packed, but the bleeding persisted. The uterus was large, but firm, at this time. The blood pressure was 140/90, pulse 110, and the bleeding continued. The pack was removed and the uterus

\*Supported in part by the Douglas Smith Foundation Fund of the University of Chicago.

and birth canal re-explored, but no cause for hemorrhage was found. A blood transfusion was started through the antecubital vein. A subsequent blood pressure reading was 30/0, pulse 150.

The patient was prepared for hysterectomy and veins were exposed for cannulation in both legs. The cubital administration of blood decreased to a few drops per minute. Efforts to increase the inflow of blood with positive pressure proved futile, due to the collapse of the venous system. In the meantime the abdomen was opened and the uterine vessels were clamped, but the patient ceased breathing one hour and ten minutes following delivery and one hour and twenty-five minutes after the tetanic uterine contractions started. The estimated blood loss was 2,500 c.c.

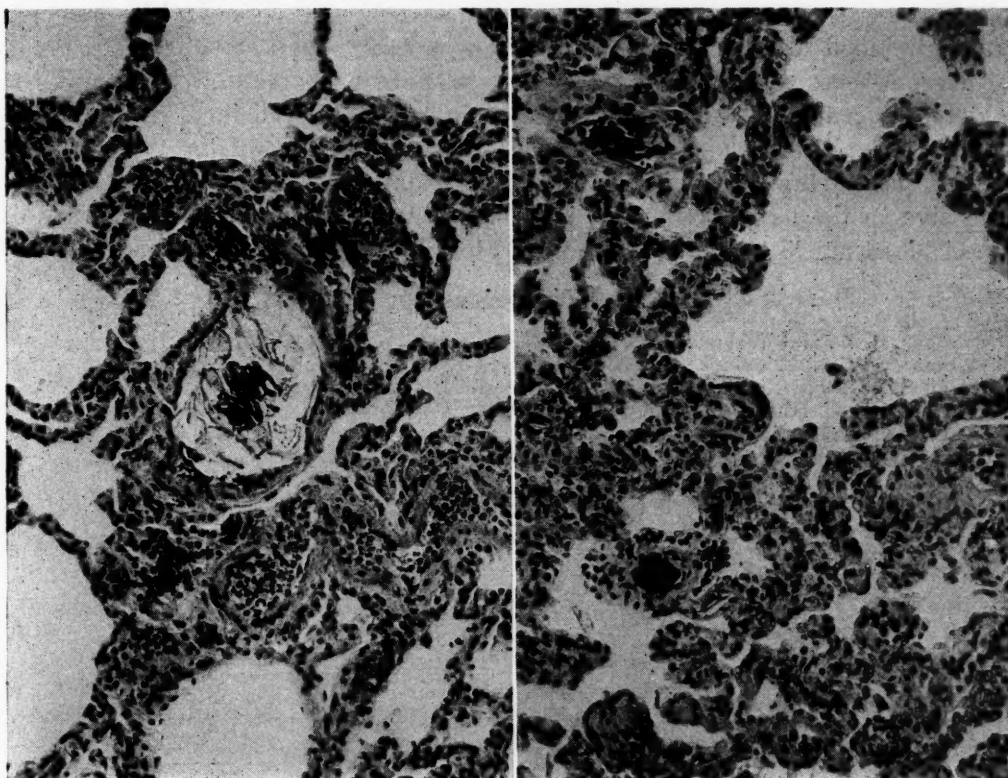


Fig. 1.

Fig. 2.

Fig. 1.—A small branch of the pulmonary artery contains squamous epithelial cells and adjacent capillaries are obstructed by brown amorphous debris. (Hematoxylin and eosin.  $\times 250$ . Reduced one-third.)

Fig. 2.—Many small pulmonary arteries and capillaries contain squamous cells occurring singly and in small clumps. (Hematoxylin and eosin.  $\times 250$ . Reduced one-third.)

Autopsy findings were as follows: There were two areas of the cervix, one on each lateral wall, where gaping varices were visible. Both showed direct communication with the main uterine veins.

All microscopic sections of the lungs showed a widespread and marked embolization of the small pulmonary arteries and capillaries by many elements of the amniotic fluid, consisting principally of squamous epithelium and amorphous bluish-brown detritus. No lanugo hairs or meconium could be identified (Figs. 1 and 2).

An adenoma malignum of the transverse colon and a hepatic-cell adenoma were reported.

It is our impression that the amniotic fluid entered the maternal circulation through the open sinuses described previously. This case demonstrates that even with modern hospital facilities and with adequate help, the medical personnel may be unable to combat postpartum hemorrhage because of circumstances beyond their control.

Recently several investigators have contributed to the understanding of the mechanism of blood clotting as it relates to pregnancy. In particular, the possible action of placental and fetal derivatives in cases of fatal hemorrhages are being studied (Seegers and Schneider<sup>3</sup>). According to Weiner and Reid,<sup>2</sup> the amniotic fluid may possess a coagulant activity which contributes to intravascular clotting and defibrination ensues. They suggest that this may predispose to postpartum hemorrhage. Ratnoff<sup>4</sup> and Vosburgh<sup>4</sup> observed multiple blood-clotting defects in a case of amniotic fluid embolism.

From these and other investigations it seems probable that there may be a defect in coagulation associated with, or induced by, elements of the amniotic fluid, with abruptio placentae or with erythroblastosis fetalis, resulting in severe postpartum hemorrhage. If the postpartum hemorrhage is not responsive to the usual treatment, it is advisable to administer 400 to 500 c.c. fresh blood and 5 to 8 Gm. fibrinogen, along with the citrated blood.

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## BLOOD COAGULATION DEFECT ASSOCIATED WITH ABRUPTIO PLACENTAE FOLLOWING TRAUMA

### A Case Report

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IN THE recent literature, reports of fibrinogenopenia associated with abruptio placentae have been made.<sup>1, 2, 3</sup> Schneider produced premature separation of the placenta artificially in pregnant rabbits by traumatizing the uterus, with subsequent intravascular clotting resulting in fibrinogenopenia.<sup>4</sup> The mediator of the intravascular coagulation is felt to be a thromboplastin-like substance.

The fact that abruptio placentae can result from trauma has been generally accepted—a jar, kick in the abdomen, action of a purgative, coitus, and even severe coughing have all been given as causes.<sup>5, 6</sup>

In 1901, Holmes reported 200 cases of abruptio placentae, 67 of which he attributed to trauma.<sup>7</sup> At the present time it is felt that trauma rarely is responsible for premature separation of the placenta, and, if due to trauma, it more often follows internal trauma resulting from manipulation or operative interference rather than external violence.

Davis and McGee<sup>8</sup> reported 3 out of 164 cases of abruptio placentae where it was felt that trauma was the etiological factor, an incidence of 1.8 per cent. In their total number of cases of abruptio placentae, they reported an incidence of partial separation of the placenta of 1 in 224 deliveries; complete separation of 1 in 770 deliveries, 28 per cent of which had typical Couvelaire uteri (15 cases out of 52). In a group of 170 cases of abruptio placentae only 1 was attributed to trauma (Lull and Kimbrough<sup>9</sup>).

In reporting a case of abruptio placentae not associated with trauma, DeLee<sup>10</sup> in 1901 observed what he called a "temporary hemophilia" and remarked in reference to the vaginal delivery which resulted in a fatality from uncontrollable bleeding that, "A Caesarean Section would probably have been fatal from hemorrhage . . . had an incision been made, the suture would not have stopped the bleeding."

The case herein reported is that of an ablatio placentae following an automobile accident, with failure of the blood to clot, which is felt to be the counterpart in a human being of the work carried out by Schneider on the uterus of pregnant rabbits.

B. J., Q.G.H. No. 13210, an 18-year-old para i, gravida iii, Negro woman, was admitted on Nov. 23, 1951, at 3:00 A.M. with a history of having been in an automobile

accident 8 hours prior to admission. She claimed that she received a blow to her body causing the thighs to jackknife forcefully against the abdomen when the car came to a sudden stop.

She was taken from the scene of the accident to one of the local hospitals where she was examined and advised to "go home and rest." One hour later she experienced severe abdominal pain which was constant. She felt no fetal movements since the accident.

Her last menstrual period was May 25, 1951, and estimated date of confinement March 2, 1952. She was approximately 6 months pregnant.

She had no prenatal care and pregnancy was uneventful with a weight gain of 10 pounds, no headache, no scotomas and no ankle edema.

The obstetrical history revealed that she had had a spontaneous late abortion at 5 months' gestation in 1949 and a normal full-term spontaneous delivery in 1950. Pregnancy and delivery were uneventful.

On admission, she was given morphine sulfate,  $\frac{1}{6}$  grain, for pain. Physical examination on the obstetrical ward revealed a well-developed, well-nourished Negro woman complaining of diffuse abdominal pain.

The blood pressure was 106/60, pulse 90 per minute, temperature 99° F.

Abdominal examination revealed the fundus of the uterus to be 28 cm. above the level of the symphysis. The uterus was in a constant state of tone, failed to relax, and was moderately tender. Fetal parts were difficult to outline and fetal heart tones were not heard. Rectal examination revealed the cervix to be thick, uneffaced, and there was no evidence of vaginal bleeding. The extremities showed no edema.

The resident was not called until 5:30 A.M. at which time urinalysis revealed a 3 plus proteinuria, specific gravity 1.020; hemoglobin 4.0 Gm. per cent, and erythrocyte count 1.9 million per cubic millimeter. She appeared extremely restless; the conjunctivae were markedly pale; the blood pressure was 90/60; and pulse 110. The abdomen revealed the uterus to be ligneous in consistency and diffusely tender. No fetal heart tones were heard and the height of the fundus was 30 cm. above the level of the symphysis. Re-examination of the cervix showed findings unchanged from those on admission.

Blood taken for clotting time determination failed to clot and showed no apparent prothrombin activity. Blood transfusion with fresh whole blood was started and the operating room alerted for a laparotomy.

At 7:55 A.M., the patient expelled approximately 1,000 c.c. of nonclotting blood per vaginam. At 8:30 A.M., while the second and third pints of blood were running, a laparotomy was performed under gas-oxygen-ether anesthesia, and revealed a uterus that was enlarged to a full-term gestation with several subperitoneal hemorrhages seen on the anterior wall. The bladder flap was reflected off of the lower uterine segment and a vertical incision was made into the lower uterine segment. On opening the uterus, a nonmacerated 6 month sized fetus, placenta, and approximately 1,000 c.c. of blood with about 200 c.c. of blood clot cascaded from the uterine cavity. The uterus was atonic and failed to contract after the intravenous administration of ergonovine and intramuscular Pitocin. Examination of the posterior wall of the uterus revealed multiple areas of subperitoneal hemorrhages extending into both broad ligaments, round ligaments, and ovaries. With warm laparotomy pads applied to the uterus while the uterine incision was sutured, the uterus contracted satisfactorily one-half hour after the incision was made, and bleeding was controlled.

The patient tolerated the anesthesia and surgical procedure well and maintained a blood pressure in the range of 110/40 and a pulse of 90 to 100 per minute throughout the entire operation.

On return from the operating room, repeat hemoglobin test revealed 5.8 Gm. per cent and the patient was given another 500 c.c. of fresh whole blood. Blood chemistry determinations taken on admission showed blood urea nitrogen 16 mg. per cent, uric acid 2.2 mg. per cent.

On the first postoperative day, the patient was given another 500 c.c. of blood. The patient appeared fairly comfortable, the abdomen soft and flat. The blood pressure was 120/70. Urinary output for the previous 24 hours was 500 c.c. of dark smoky urine.

Urinalysis showed 1 plus proteinuria with occasional granular casts, specific gravity 1.024. Clotting time was 5 minutes, prothrombin activity 87 per cent of normal, and hemoglobin 7.0 Gm. per cent.

On the second postoperative day, the blood pressure was 120/70. Urinary output during previous 24 hours was 2,000 c.c. of clear amber urine. There was no proteinuria, and the specific gravity was 1.018. Hemoglobin was 8.5 Gm. per cent. Sick-cell preparation was negative for sickling. Blood chemistry determinations showed total protein 5.4 Gm. per cent; albumin 3.4 Gm. per cent; globulin 2.0 Gm. per cent; blood urea nitrogen 7 mg. per cent; uric acid 3.1 mg. per cent; prothrombin activity 100 per cent of normal.

On the fifth postoperative day the patient was given another 500 c.c. of whole blood.

She had an uneventful postoperative course and was discharged on the twelfth postoperative day with a hemoglobin of 10.5 Gm. per cent and apparently no residual renal damage.

### Summary

A case of abruptio placentae following an automobile accident with the failure of the blood to clot is reported. The abruptio was severe, with concealed hemorrhage for the most part, and evidence of some degree of renal failure manifested itself. It is felt that the abruptio placentae, with its sequence of autoextraction of thromboplastin-like substance from the torn decidua tissue, resulting in intravascular clotting and defibrination of the blood, was directly attributable to trauma to the uterus which was sustained in an automobile accident.

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## REVERSE FORCEPS

### A New Instrument Designed to Facilitate Delivery of the Head, in Cesarean Section

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THESE forceps were devised for use in cesarean section, to replace the conventional forceps. The instrument greatly facilitates delivery of the head and minimizes trauma to both mother and infant. Their use is indicated in transperitoneal or low cervical cesarean sections, and in the extraperitoneal operations. They are valuable also in the occasional classical section, where, after delivery of the body, one encounters difficulty in extracting the head, because of moderate hydrocephalus, disproportion, or malposition. Especially following hours of test labor, this instrument serves a very useful purpose.



Fig. 1.—Bay Jacobs reverse forceps. The cephalic curve is long and wide. There are ample pelvic curve and practically no shank. Although short and light, the forceps are durable.

The conventional obstetrical forceps were designed for the delivery of the head through the outlet of the pelvis. Features considered necessary are the cephalic curve and, in most instruments and for most purposes, an adequate pelvic curve. To be applicable at the various stations of the head, and for mechanical efficiency, the shank and handle must be fairly long. Some forceps deliveries are unusually difficult and once forceps are applied the intention usually is to bring the head through the birth canal in spite of all hindrances. Long shanks, long handles, and various traction devices serve to perform that function. Since no obstacle exists outside of, or anterior to, the outlet and vulva, there is ample area to maneuver large and bulky instruments.

When a head is to be extracted in the reverse direction, entirely different circumstances are encountered. Instead of the unobstructed area that exists in front of the vulva, there is the marked protrusion of the abdomen and term uterus. Also, in this instance, the element of time is very important.



Forceps for such a purpose should be short and light. Long handles and long shanks, besides being cumbersome to apply and maneuver, may result in the application of too much force, for they would function as the long arm of a lever, with the fulcrum close to the head.

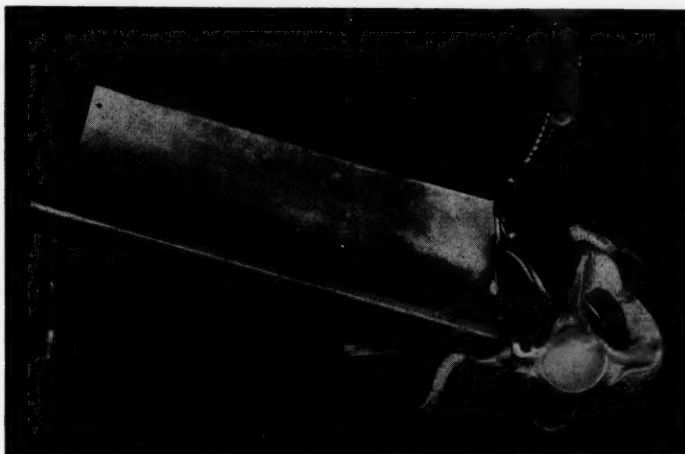


Fig. 2.—Forceps are being held in the middle of the birth canal, so that the pelvic curve is in the axis of the pelvis (curve of Carus). Note direction of handles upward and slightly forward.

The metal manikin is in the position that the female pelvis assumes in the recumbent posture.

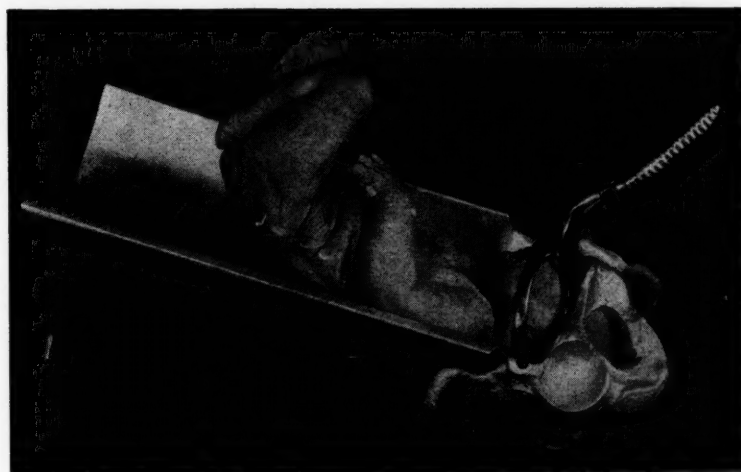


Fig. 3.—Note that all manipulation is away from the term uterus or even a protruding fetus. This makes application a simple procedure.

These forceps embody the essential requirements. They have a large cephalic curve and a pelvic curve that conforms nicely to that of a normal female pelvis. There is practically no shank (Fig. 1). The angle between the handle and blade is such that when the blade is being guided between the head and lateral wall of the pelvis, the handle points almost directly upward and slightly forward, thus avoiding any obstacle to easy application (Fig. 2). Even in a classical section, where the body has been delivered and forceps must be applied to extract

the head, the bulk of the body and its direction do not render the application (Fig. 3) difficult as when instruments of classical design are used (Fig. 4). As the blades bring the head upward through the birth canal, the handles assume a direction that is more forward and out of the way (Fig. 5).



Fig. 4.—This special manikin (Bay Jacobs metal manikin) supports the fetal body in the same relation as it occupies in utero.

It is evident that the fetal body interferes with the application and maneuverability of conventional-type forceps.

In the event that the body were delivered and the head wedged into the pelvis, as might occur in a classical operation, the difficulties become aggravated.

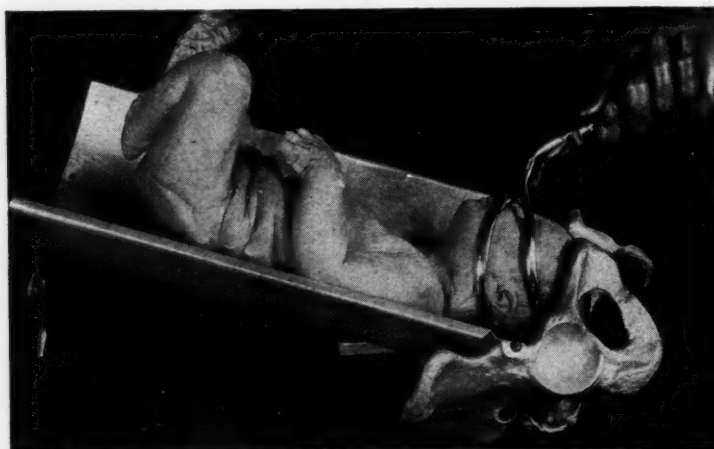


Fig. 5.—Traction on the handles in a forward and upward direction causes ascent of the head.

In many cases of low cesarean section, for various reasons, the head may be floating above the inlet. Usually, the operator's hand is inserted into the uterine incision below the head and delivery effected by the assistant making pressure on the fundus. The head could be more readily lifted through the thinned lower uterine segment with less risk of

extending the incision if these forceps were applied with the handles directed toward the head of the patient. In all cases where the head is in or below the inlet, application should be made as shown in the illustrations.

The instrument could be made with semifenestrated blades, a feature which I had patented many years ago, and which seem universally to bear the misnomer of "Luikhart forceps." Where forceps are especially designed for rotation, such as the ones I had invented for delivering the persistent occiput posterior, the semifenestrated blade has some merit. Where rotation is not a factor, the fenestrated blade presents the advantage of lightness, as well as improved facility of taking adequate hold on the head.

Application of the reverse forceps\* is a very simple procedure. Since the cephalic curve is large, the handles come together readily, and excessive compression of a skull of normal size should not occur. Since the instrument is short and light, trauma to the fetus or the mother is not likely, if reasonable skill is exercised.

It seems quite evident that for the purpose of delivering a head in the reverse direction, these forceps surpass the classical instrument. One can readily understand also that various conditions may exist where this instrument can be more efficiently and effectively applied than a vectis.

WASHINGTON MEDICAL BUILDING.

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\*These forceps are manufactured by The Max Woehner and Son Co., Cincinnati, Ohio.

## MARYAN'S IMPROVED BLOODLESS CIRCUMCISION CLAMP\*

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THERE are numerous ways of performing circumcisions. The usual performance of circumcision on the infant by the excision method, or the excision and suture method, is supposedly simple but rather cumbersome. The results are sometimes startling, because hemorrhage and infection are common occurrences, and either too much or not enough foreskin is removed, or the tip or part of the glans is cut off. Consequently, the end result is a mutilated, bent, or ragged-looking penis. Medical literature records that fatal hemorrhages occur occasionally and many infections are fairly common as a result of circumcision in the newborn. It is estimated that 2 per cent of all skin carcinomas are penis carcinomas.

Yellen,<sup>1</sup> in 1935, developed a clamp for bloodless circumcisions. A new simplified bloodless circumcision instrument, devised by me, is constructed with three progressive cups. It is found necessary at times to perform a circumcision on an infant with a slightly larger glans penis. With this universal circumcision instrument such a problem is easily solved by using the next adequately sized cup, either the extra small cup, or the newborn-sized cup, or the youth-sized cup. The former two cups are the ones commonly used for the premature infant, the full-term newborn infant, or the 6-month-old infant. The youth-sized cup is used for infants during the latter part of the first year, and also for children from 1 year of age up to 5 or 6 years old. With these simplified circumcision instruments, hemorrhages and infections are rarely encountered. At the Frank Cuneo Memorial Hospital during the past ten years we have seldom encountered these complications.

It was customary to perform a circumcision the eighth day after birth, but now, through the early ambulation and speed-up system of discharging the parturient mothers from hospitals, circumcisions are done about the fourth or fifth day after birth. We perform circumcisions on premature infants who weigh 5 pounds or above, and on full-term infants who show no abnormal subjective or objective symptoms. Every infant must have a complete blood count, a prothrombin time and bleeding and coagulation time determinations taken before the circumcision is performed. Various investigators<sup>3</sup> have shown that there is a hypothyrombinemia in newborn infants after the first day of life and from the third to the fifth day. Vitamin K is routinely administered to all mothers in labor. Vitamin K increases available prothrombin, thus shortening the prothrombin time.

\*Presented before the Chicago Gynecological Society, May 16, 1952.



In general, the improved clamp (Fig. 1) includes a base plate with three openings (Fig. 1, *D*), each flaring downward and outward toward the bottom. These openings are of different diameters to accommodate penises of varied sizes. Associated with the base plate, there

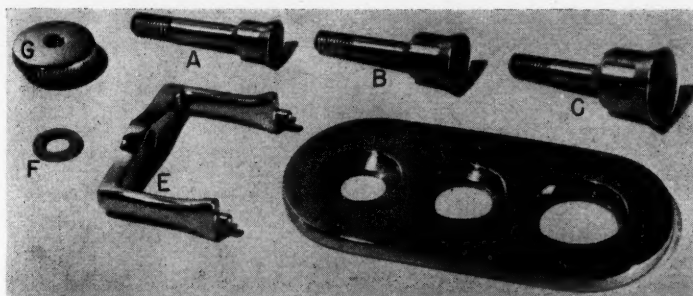


Fig. 1.

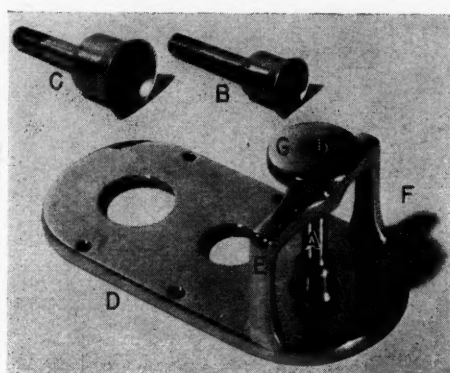


Fig. 2.

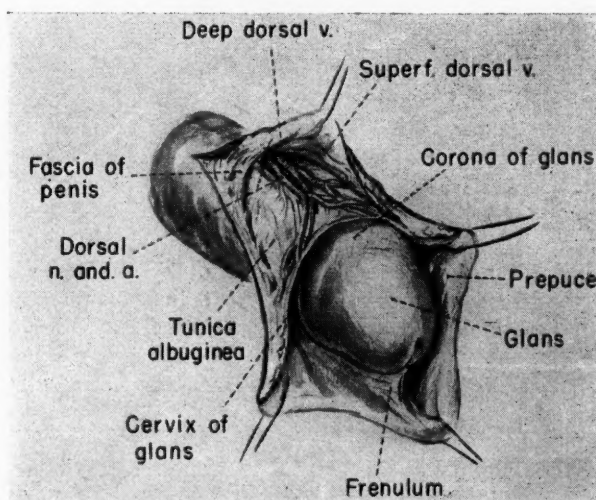


Fig. 3.

are three stemmed cups, each sized in diameter for use in an associated opening (Fig. 1, *A*, *B*, *C*). These cups are of the same length. Also associated with the base is an inverted U-shaped yoke (Fig. 2, *E*) that may be positioned for use with a base plate opening of

selected size. By turning the nut (Fig. 2, G) sufficiently and in the proper direction, an upward straight line axial lift is imparted to the stem while, at the same time, the yoke is forced downward upon the base member. In this rectilinear or upward pull movement of the stem, the flared bottom end of the cup approaches more closely the flared beveled wall of the opening, thereby uniformly compressing the prepuce against the cup, producing an ischemia of the prepuce above the base plate with agglutination of the skin and mucous membrane and hemostasis.

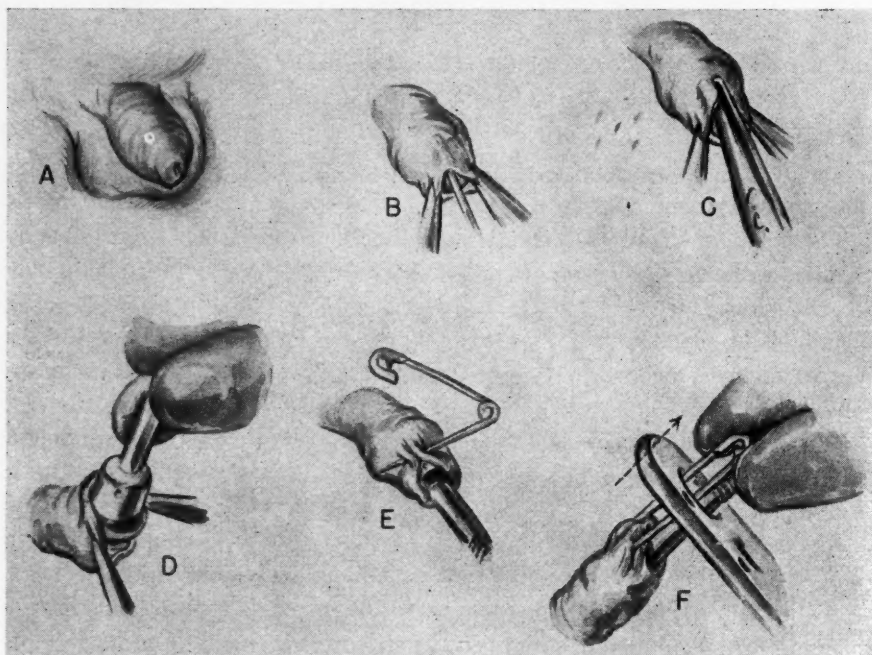


Fig. 4.

The prepuce covering the glans penis (Fig. 3) has a rich blood supply. The superficial dorsal vein and dorsal artery send off lateral branches between the mucous membrane of the skin of the prepuce and the median raphe of the frenulum. Terminal filaments of the dorsal nerve of the penis supply the prepuce. Usually when hemorrhage does occur at any time, it is from the median raphe of the frenulum, and at times it is very difficult to control because of retraction of vessels and sparse raphe.

The technique of performing a circumcision with this new universal clamp is simple. The baby is placed on a Y-shaped wooden board, pinned down to the board with towels to prevent moving of the arms or legs during the operation. No anesthetic is used, but a sugar-saturated small gauze sponge may be placed in the baby's mouth if desired. This may help reduce the amount of crying. No assistant is necessary.

The penis, scrotum, and surrounding area are washed with green soap and water. A sterile towel with a hole in the center is placed over the baby in such a way that the penis protrudes through the hole. The operation is performed under sterile technique, the steps of which are as follows:

1. The preputial orifice on each side of the dorsum of the prepuce is grasped by a mosquito forceps (Fig. 4), stretching the prepuce.
2. A small round ball-pointed probe anointed with petrolatum is inserted between the prepuce and the glans to separate the adherent mucous membrane. By rotating the probe beyond the corona and throughout the glans and to each side of the frenulum the prepuce is thoroughly loosened (Fig. 4, B).

3. A partial dorsal slit is performed which facilitates applying the cone. The slit should be made only sufficiently long to enable the cone to be easily applied (Fig. 4, C).

4. The cone is placed over the glans penis, pressed down over the corona into the sulcus, and not between the skin and mucous membrane, allowing enough of the mucous membrane to fit below the cone so that too much is not removed. Care must be taken that the frenal relationship of the cone is undisturbed. The small upper vent in the cone eliminates the resistant air pressure and accumulation of oozing blood (Fig. 4, D).

5. Insert a safety pin through the lower edges of the dorsal slit, pin the edges together, and draw them up longitudinally with the safety pin parallel to the glans (Fig. 4, E).

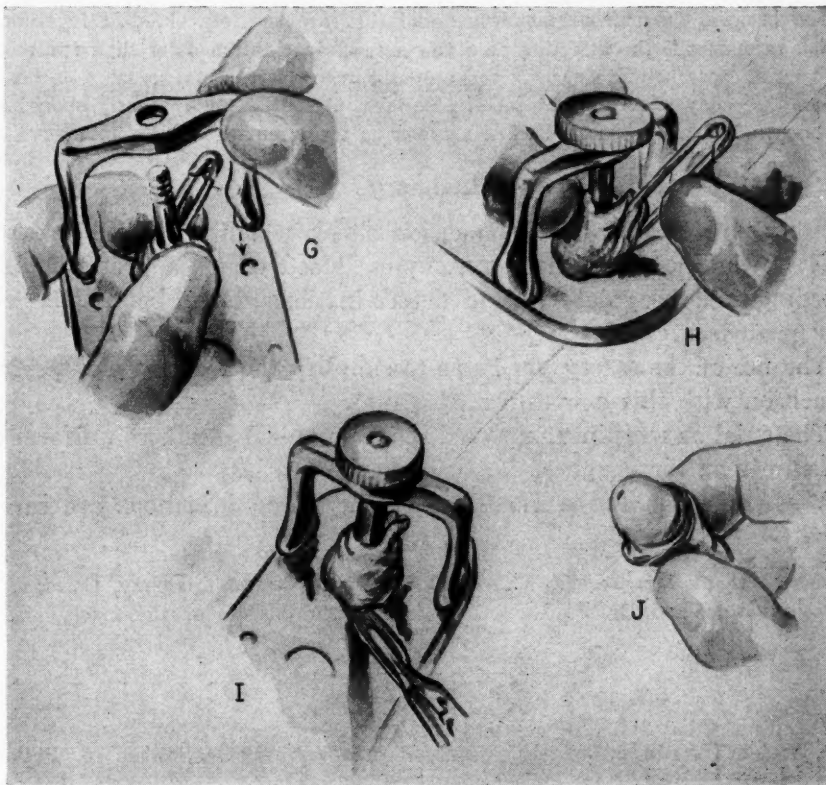


Fig. 5.

6. Now pass the bevel opening of the base plate over the stem and safety pin, continue pulling upward upon the safety pin until the entire prepuce is drawn through and the cup becomes engaged with the anterior opening of the base plate (Fig. 4, F).

7. The inverted yoke (Fig. 5, G) is now put in place by passing the central opening of the upper arm through the threaded stem, and the stubs of the legs into the pilot openings of the base plate. By turning the nut clockwise sufficiently, the prepuce is now clamped in place. Avoid taking off too much or too little foreskin, by leaving some slack at the base of the bell. See that there is sufficient skin left on the dorsum and front of the penis. In manipulating the safety pin this can easily be done (Fig. 5, H). By means of this upward pull of the cup, the prepuce is crushed against the cone causing hemostasis. We let this pressure remain usually five minutes. Let the clamp rest on one of the thighs during this period.

8. The redundant preputial tissue is cut away with a sharp Bard-Parker scalpel inclined at a 45 degree angle by encircling the bell at the base plate without any danger of cutting

the glans which is always protected by the bell. There is plenty of room between the legs and the bell. Leave no frayed edges. If there is some oozing, leave the clamp on five minutes longer (Fig. 5, I).

9. Release the clamp and slip the bell off the glans. The circumcision is completed (Fig. 5, J), leaving a fine  $\frac{1}{32}$  inch ribbonlike membrane between the new union of the skin and mucous membrane. Wipe away any smegma. Be sure that the skin and mucous membrane are free from the corona. Some petrolatum is placed over the circumcision area and covered by a small gauze flat. I have not found it necessary during the past ten years to use a pressure petrolatum ribbon bandage.

With this method we never employ sutures. No bleeding is encountered and it leaves a clean-cut incision which heals perfectly within 36 to 72 hours, with practically no change of infection because the mucous membrane and skin are securely clamped together.

Yellen recommends the insertion of a few sutures in children older than twelve months.

My routine postoperative care is to apply saturated petrolatum gauze 4 inches square, for the first three days. After that the circumcision is kept clean by gently sponging whenever necessary. The baby can be bathed as soon as the circumcision is completely healed.

### Summary

1. A simplified bloodless circumcision clamp which I devised is described.
2. Every infant should have a complete blood count, a prothrombin time, and bleeding and coagulation time determinations taken before the circumcision is performed.
3. The use of the safety pin helps to simplify the technique of performing a circumcision with this new universal clamp.
4. The axial or rectilinear upward pull of the bell produces uniform clamping pressure upon the prepuce.
5. With this bloodless method, hemorrhages and infections are rarely encountered.

I wish to thank Mr. George Wallerich of V. Mueller and Company, Chicago, for his untiring cooperation, and Dr. Paul Pessl for suggesting the use of the safety pin.

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30 N. MICHIGAN AVENUE



## CERVICAL ELEVATOR FOR USE IN COMPLETE HYSTERECTOMY

HENRY LEIDENHEIMER, JR., M.D., F.A.C.S., NEW ORLEANS, LA.

(From the Department of Obstetrics and Gynecology, Louisiana State University  
School of Medicine)

THE instruments already devised for complete hysterectomy would seem sufficient for any exigency likely to arise during its performance. There is sometimes, however, a good deal of difficulty in elevating the cervix in a short, obese woman with a deep pelvis, particularly when the uterus is so enlarged by fibroids that the fundus has to be amputated to give enough working space for the removal of the cervix. This combination of circumstances is not infrequently encountered on gynecologic services in the South, on which large numbers of Negro women are treated.

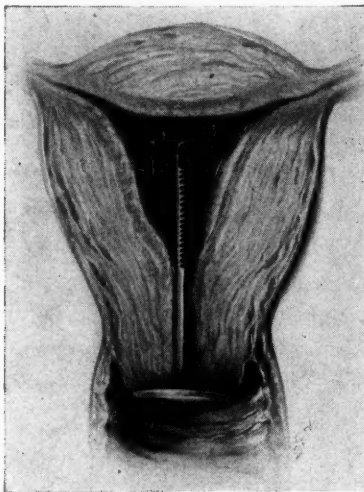


Fig. 1.—Cross section showing cervical elevator after its introduction into the cervical canal. Note serrations in stem, and eye into which clamp may be introduced to produce traction in cases in which fundus is amputated before cervix is removed.

The cervical elevator described in this article was devised to overcome these difficulties. It is made\* of stainless steel and consists of a round disk mounted on a stem or rod (Fig. 1). The disk is 2.5 cm. in diameter and 2.5 mm. thick. It is convex on the distal surface and concave on the proximal surface, to conform to the contour of the surface of cervix. The stem is 6.5 cm. in length and 5 mm. in diameter. Serrations along its surface increase traction in the cervical canal and prevent its slipping out after it has been inserted. At the end of the stem is an eye 5 mm. in diameter, into which a clamp may be applied for purposes of abdominal traction.

\*The instruments which we are using were made by Coshov's Specialty Shop, New Orleans.

The instrument is introduced into the cervical canal after vaginal preparation is completed. Occasionally, if the cervix is nulliparous and closed, it must be introduced under full vision, with the aid of a vaginal speculum or retractor. Ordinarily it can be introduced blindly.

Once the abdomen is opened, the disk can be felt beneath the cervix and the vaginal mucosa can be cut or clamped below it, depending upon the technique employed. If the fundus has been removed as the first step of the procedure the eye at the end of the stem can be grasped with a clamp, as already noted, to produce traction.

Although this instrument was devised only for the special cases described, it proved so useful in them that it is now used almost routinely on our service at Charity Hospital of Louisiana. No difficulties have been encountered in the approximately 200 complete hysterectomies in which it has been employed during the past year. The only conceivable risk, in fact, is that, if the elevator is introduced carelessly or with too much force, the cervical neck might be penetrated at its junction with the uterus. If such an accident should occur, the harm would be slight. The point of penetration would be too far above the bladder to cause any damage anteriorly, while perforation of the uterus would not be a serious matter since the organ is to be removed in a matter of minutes. In our own experience, the rod has followed the course of the cervical canal in every case in which it has been used, and the risk mentioned seems to us entirely theoretical.

## Editorial

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### A Report on the First Year

A little over a year has passed since two very new editors took over the responsibilities of the JOURNAL from the experienced hand that had guided it since its founding. It is far too early to point to any accomplishment, but it seems proper at this time to explain certain policies and methods of organization that may be of interest to both readers and contributors.

Manuscripts are received and may be accepted by either editor to whom a contributor may decide to direct them. In general, however, we have suggested that a vaguely defined geographic division of the country, based on the Appalachian Mountains, determine to which editor a manuscript be primarily sent. This promises to divide the manuscripts into two groups of about equal size.

According to the plan that was adopted, either of us on his own responsibility may accept any manuscript sent to him, but it may be rejected only upon mutual decision. An exception to the rule is made in the case of manuscripts coming from outside of the United States or Canada, all of which are to be read by both editors. The mail between New York and Chicago has been substantially increased during the last year as a result of the number of submitted articles shuttling back and forth pending final decision. In cases of disagreement between the editors, and in instances of articles on special topics upon which we have felt ourselves incompletely qualified, manuscripts have been referred to members of the Advisory Editorial Committee for their advice. We do not think that many mistakes have been made in the rejection of articles during the last year.

An effort has been made also to make somewhat closer the relationship between the JOURNAL and the societies which sponsor it. Each editor has accepted special responsibilities for the scientific material presented before the societies of his area and has endeavored to establish a closer relationship with the secretaries of these societies. Efforts have been made to encourage the societies themselves to participate in the decision as to the desirability of publishing articles read before their meetings. Proper decisions are of equal importance to JOURNAL and society since each receives credit or risks discredit for the material that is printed.

A final measure to place a part of the control of JOURNAL management in the hands of the specialty and of its constituent societies has been the setting up of the Advisory Policy Committee. Members of this committee, whose names appear in each number of the JOURNAL, have been selected informally to represent special groups or areas of the country. This committee will meet

as a body once a year. The last meeting, held in Chicago on Oct. 8, 1953, was well attended. The atmosphere was friendly but not so friendly as to preclude some definite suggestions and some precise criticisms. These, it is hoped, will all be reflected in future JOURNAL policy.

The material submitted to the JOURNAL during the past year has at times been disappointing. Many articles received have been beautifully written, the subject presented in a logical fashion, illustrations and bibliography in such perfect order as to promise an easy life to the editors.

Others have indicated a surprising lack of knowledge of the English language as well as a carelessness for figures, spelling, and the selection of material, especially pathologic, for illustrations which is quite alarming when coming from men whose lifework requires in general such precision. We are promising ourselves a future opportunity for more detailed editorial comment on our contributors. This is not, however, our present purpose.

The intent today is to indicate to our readers and contributors some of the steps that have been taken to safeguard their interests and further to point out channels by which their own criticisms may be received. Letters sent directly to the editors will receive careful consideration, or if the writer prefers more personal representation comments may be sent to any member of the Advisory Policy Committee whom he may select. We are convinced that no conflict in interest exists between readers, contributors, and editors and that mutual criticism can only be of material benefit.

*The Editors*



# Department of Reviews and Abstracts

CONDUCTED BY GEORGE W. KOSMAK, M.D., NEW YORK

## Review of New Books \*

EDITED BY LOUIS M. HELLMAN, M.D., BROOKLYN, N. Y.

### Obstetrics

**A Guide to Obstetrics in General Practice.** By William C. W. Nixon, M.D., F.R.C.S., F.R.C.O.G., and Eric B. Hickson, M.R.C.S., L.R.C.P., Dr. (Obst.) R.C.O.G. 301 pages with 35 figures. London, 1953, Staples Press, Inc. \$6.00.

Although more and more expectant mothers are being cared for by obstetrical specialists, many women are delivered by general practitioners. Therefore the book under discussion is timely. The style makes it easy to read and the material is arranged in a logical manner.

The psychosomatic phase of pregnancy is emphasized but not given more attention than it warrants. However, the mental attitude of the patient is most important and it is refreshing to have this phase of obstetrics treated in a sensible manner. Even specialists could profit from the reading of this portion of the book.

Very little criticism can be made of the methods suggested for the handling of abnormal pregnancy and labor. The treatments are in conformity with present-day thinking and if followed would do much to decrease infant and maternal mortality.

The need for analgesia and anesthesia is recognized, but the chapter on this phase of labor emphasizes the safeguards that should be employed by the general practitioner especially where trained anesthetists are not present.

Considerable space is given to the problem of breast feeding and it is refreshing to find this phase of the puerperium given the attention it deserves. Our associates in England stress the importance of breast feeding much more than we do in this country.

The care of the newborn, including the premature infant, is treated quite adequately for the general practitioner, covering forty-five pages.

The subject of obstetric operations is covered very lightly, as it should be in this type of publication, for this phase of obstetrics should be for the most part relegated to the specialist.

All in all this is a worth-while book and should find a wide demand.

**Analgesia and Anesthesia in Obstetrics.** By J. P. Greenhill, M.D. 85 pages with 16 illustrations. Springfield, Ill., 1953, Charles C Thomas.

One would expect any publication from this author to be worth while. This monograph is no exception. The brevity of the book is unfortunate but this is in part compensated for by the sage opinions of the author.

The monograph is divided into eleven sections ranging from two to twenty pages each. The section on hypodermic, oral, and rectal agents is particularly good since the

\*The Advisory Committee on Policy has agreed that most book reviews need not be signed.

pharmacology, the effect on the child, and the effect on labor are given for each drug. The section on direct infiltration anesthesia is excellent.

The major criticism lies in the failure of the monograph to include the newer catheter techniques of caudal anesthesia and a section on infant resuscitation and anesthesia for obstetrical difficulties.

**The Vitamins in Obstetrics.** By Martial Dumont. 152 pages. Paris, 1953, Masson & Cie.

Professor Dumont of the Faculty of Medicine at Lyon has gathered into a monograph of modest size a comprehensive and critical summary of modern knowledge concerning the role of the various vitamins in normal and pathological pregnancy. He has provided a very thorough bibliography, together with a summary of the various technical methods in use for vitamin assays. Each of the vitamins is considered systematically, so that, in effect, this book constitutes a welcome extension of the sometimes all too curtailed material available on this subject in standard textbooks of obstetrics. The style of the work is admirable. Dumont writes clearly and explicitly, so that anyone with a reasonable command of French will find the information here provided readily accessible. The publishers have printed the work on excellent paper and in clearly legible type. All American medical libraries and those obstetricians who read French with reasonable fluency should have this useful reference book on their shelves.

**A Modern Practice of Obstetrics.** By D. M. Stern and C. W. F. Burnett, M.D. 248 pages with 140 line drawings and 3 appendices. Baltimore, 1952, Williams & Wilkins Company. \$7.00.

It is apparent from the small number of pages that this book is equivalent to a synopsis of obstetrics, but, despite its brevity, it is fairly complete and concise. Although some important subjects are discussed in chapters only two pages in length, enough information is presented to acquaint the student or midwife with the topic to prepare him, or her, for examination. Much of the text is in outline form, the drawings are clear, and facts are straightforwardly presented, with little or no theoretical discussion nor references. The text and treatment are in line with modern obstetrics, and there is little with which one can disagree.

Not only is this book beautifully written, with two-column format and clear type, but each chapter is prefaced by an apt quotation from one of Shakespeare's plays. From the title page there is, "There's for thy labour" (Henry V, III. vi. 170). The two-page chapter on antepartum hemorrhage has "O, heaven! look how our daughter bleeds!" (Romeo and Juliet, V. iii. 202). The chapter on the third stage of labor is prefaced by: "Follow her close; give her good watch" (Hamlet, IV. v. 75). For the chapter on maternal injuries: "Behold the wounds, the most unnatural wounds" (Henry VI, Part I, III. iii. 50). For obstetric operations: "was from his mother's womb Untimely ript." (Macbeth, V. viii. 14.) Heading the chapter on abnormal uterine action is: "I will deliver you. . . . Meantime, have patience." (Richard III, I. i. 115.) For abnormal presentation in pregnancy and labor: "'twill hardly come out. Ha! bots on't, 'tis come at last" (Pericles, II. i. 117). Many more pertinent quotations could be requoted would space permit. The frontispiece is an extract from the 1752 William Smellie *Treatise on the Theory and Practice of Midwifery*, outlining "The Requisite Qualifications of Accoucheurs, Midwives and Nurses who attend Lying-In Women."

The book will make good reading for those who would like to review an obstetrical text, as well as for students and others preparing for examination.

**Obstetrica Practica Version.** By Juan Leon. 102 pages with 96 illustrations. Buenos Aires, 1952, Editorial "El Ateneo" Libreria.

This is one of a series of fascicles on obstetric practice. It is a manual on version in obstetrics, and, as such, is very well written and illustrated. Every type of version is

discussed from the historical point of view, with listing in outline form of the reasons for the various procedures described. There are succinct discussions of causes for the various fetal positions, and indications and contraindications for version.

The American literature on the subject and American textbooks are extensively quoted. The author's views are in keeping with modern obstetrical practice in regard to the dangers of the version operation, and he does not hesitate to discuss the desirability of alternative methods wherever indicated.

This manual is highly recommended for Spanish-reading students and practitioners.

**The Practical Management of Pain in Labor.** By W. D. Wylie, M.A., M.B. (Cantab.), M.R.C.P. (Lond.), D.A. 148 pages with 42 illustrations. Chicago, 1953, The Year Book Publishers, Inc. \$3.50.

The title of this small volume aptly describes its intent and scope, *The Practical Management of Pain in Labour*. Its author, W. D. Wylie, is an anesthetist who well understands the physiologic demands of the gravid patient and passenger.

The material is directed toward a concise, clear description of the mechanism of pain in the parturient, the agents for its relief, their action, and techniques for their use. Specific methods in abnormalities and complications of pregnancy are adequately dealt with.

Although evidencing a distaste for the use of barbiturates in analgesia, and acknowledging a preference for inhalation over conduction methods, the presentation is fair. The discussion of the technique and use indicates that these preferences are not based on unfamiliarity.

The black and white anatomic sketches are difficult to read, but are accurate and well drawn. Too much space is devoted to illustrations and discussion of apparatus not used or available in this country, apparently devised for use by midwives and practitioners in the home.

Recommended to obstetricians, anesthetists and general practitioners alike, the book presents facets from the point of view of each, for the enlightenment of all.

**The 1953-1954 Year Book of Obstetrics and Gynecology.** Edited by J. P. Greenhill, B.S., M.D., F.A.C.S. 567 pages with 104 illustrations. Chicago, 1953, The Year Book Publishers, Inc. \$6.00.

*The 1953-1954 Year Book of Obstetrics and Gynecology* is in hand. It contains 244 pages devoted to obstetrics and 266 assigned to gynecology. Anyone who has followed these small volumes over the years cannot help but be impressed by their continuing high standard of excellence.

Of particular value are the sections on the toxemias of pregnancy and uterine carcinoma. These two sections, and especially the latter, give a very fair survey of the year's progress in these two fields. Also of note are the collected reviews on urinary incontinence.

The editor of this volume must take the world's literature as he finds it. However, while he cannot create research he can, by emphasis, stimulate investigation in certain neglected fields. To some extent he has done this in the past, as for example, in the area of anesthesiology. It seems to this reviewer that the section on the newborn has not been given the accentuation it deserves. Fetal salvage is of growing importance and potentially more productive than sterility, which is given far more space in the present volume. In particular, the questions of retrolental fibroplasia and hyaline membrane disease are underplayed.

The editorial comments are again a delight. Although one might not always agree with them, the editor's breadth of information always makes his opinion stimulating and of real value. This is recommended reading.

**Die Geburtshilflichen Operationen.** By Prof. Heinrich Martius, Director of the University Woman's Clinic, Gottingen, Germany. Seventh edition, 280 pages with 268 illustrations. Stuttgart, 1953, Georg Thieme Verlag. DM 34.

This is the seventh edition of Prof. Martius' text on obstetrical operations. Like the rest of his works, it is concise, well illustrated, and easy to read.

This volume contains a section on the anatomy of the pelvis, followed by a detailed explanation of the various mechanisms of delivery in different presentations and positions. The technique of the various operations for delivery is next described, in great detail.

The American reader will find this volume interesting because of the picture it paints of German obstetrics. For example, the author states that in January, 1937, long before World War II, only 29 per cent of German births were conducted in hospitals. A little further on, it is noted that the physician who delivers patients at home must know how to perform forceps deliveries, breech extractions, versions, craniotomies, episiotomies, sutures of all types of lacerations, and manual removal of the placenta. In addition, he must know how to manage postpartum hemorrhage.

In the main, the indications for obstetric procedures are similar to those observed in this country. Moreover, the technical details are practically identical. A few points of difference may be noted. It is felt that high forceps operations may be performed under certain special circumstances. Occasionally, forceps may be applied to the breech. The Bracht maneuver, which has just begun to receive attention in this country, is described and illustrated. Anterior vaginal hysterotomy is still recommended in severe medical complications of pregnancy. If pregnancy should last as long as 292 days, a medical induction with castor oil, quinine, and pituitary extract is carried out. If delivery does not occur by the two hundred ninety-sixth day, the cervix is manually stretched and the membranes ruptured.

It is interesting to note that the author recommends median episiotomy for routine deliveries. The classical cesarean section has been totally abandoned. Braxton Hicks version may still be done for placenta previa.

This is an excellent book, but the teachings therein are adapted to an area in which hospitalization is not readily available for parturients.

**The Obstetrical Forceps.** By L. V. Dill, M.D., F.A.C.S. 156 pages with 91 illustrations and 86 plates. Springfield, Ill., 1953, Charles C Thomas. \$5.25.

This book is a short, well-written, and easily read monograph on the use and abuse of the most common types of forceps employed today. The methods of application, traction, and rotation are extensively described. Dill stresses that fewer maternal and fetal injuries will result if the proper type of forceps is used for different types of heads and differently shaped pelvises. For example, he describes the cephalic curvature of the Bailey-Williamson forceps and how they are best used on a small unmolded head, whereas the Simpson forceps would fit better on a large molded head.

Several chapters could be written in more detail. For example in the use of the Kielland forceps, there should be a better description of the "wandering method" of application, as well as in the use of these forceps for delivery.

The book in general is well written, and should have a place in the library of resident obstetricians.

**Die Eröffnung der Cervix uteri in der geburtshilflichen Theorie und Praxis.** By Dr. Rudolf Gross. 132 pages with 10 illustrations. Stuttgart, 1952, Ferdinand Enke Verlag. DM 12.60.

This monograph is highly recommended to all those interested in the changes that occur in the cervix during pregnancy. This is a comprehensive and up-to-date review of the literature of the anatomical, histological, and physiological changes of the uterine cervix during pregnancy.



It is a complete discussion of the theories of the incorporation of the cervix into the lower uterine segment. The clinical portion of the monograph is the discussion of cervical dystocia which is divided into three types, namely, that involving the external os, the cervical canal, and, last, the internal os.

Little disagreement will arise with the author's management of cervical dystocia except when he advises and advocates Dührssen's incisions for a rigid external os.

On the whole I find this a most complete and concise monograph on the subject of the uterine cervix in pregnancy.

### Gynecology

**Multiple Myeloma.** By I. Snapper, L. B. Turner, and H. L. Moscovitz. 168 pages with 43 illustrations and 1 color plate. New York, 1953, Grune & Stratton. \$6.50.

This is the first publication in book form on multiple myeloma, and, most appropriately, the senior author, Dr. Snapper, has long been recognized to be a world authority on this subject. An analysis of 97 patients studied at Mt. Sinai Hospital forms the main basis for the book. This is integrated with the experiences of others, which adds up to a total of 217 references. The division of contents includes a discussion of the myeloma cell, the clinical manifestations of the disease, incidence and survival, the peripheral blood picture, x-ray changes, metabolic abnormalities, pathology, differential diagnosis, and treatment. There are also chapters on solitary myeloma, and multiple and extramedullary plasmacytomas. Finally, there is an excellent summary at the end.

Of particular interest were sections dealing with the protein abnormalities including globulins, cryoglobulins, Bence-Jones protein, and the complication of primary amyloidosis, and the pathophysiology of the myeloma cell. Treatment with x-ray, stilbamidine, urethane, and ACTH is thoroughly evaluated. Illustrations, such as roentgenograms, are beautifully reproduced. Not only is this book a storehouse of knowledge, but it is charmingly written, so that the reading of it is a real delight. It can be highly recommended to all those interested in the fundamentals of medicine, including both doctors and medical students.

**An Atlas of Pelvic Operations.** By Langdon Parsons and Howard Ulfelder. 231 pages with 197 plates. Philadelphia, 1953, W. B. Saunders Company. \$18.00.

This is a fine atlas of both gynecologic and pelvic procedures. As such, the work includes some operations which have not always in the past been considered strictly in the field of gynecology. However, with the current surgical attacks on carcinoma the field of the gynecologist has been considerably broadened, and it is thus quite fitting that the problems of the lower bowel, ureters, and bladder be included in this volume.

The work follows more or less the general outline of the Cutler and Zollinger *Atlas of Surgical Operations*. It makes no attempt to describe indications for or against any operation, nor are all the procedures known to accomplish a given objective presented. Usually the standard operation is described, and occasionally variations in technique are presented, as for total hysterectomy. The text is sparse, easy to read, and to the point. The drawings are ample in number, for the most part quite clear and illustrative of the important steps of the procedure. These are line drawings of the type in which Miss Coddington, the artist, excels. Perhaps they are a little too diagrammatic and too simple to give full scope to the illustrator as an artist. It is interesting in looking back over the Cutler volume, which is done by the same artist, on somewhat poorer paper, with the same technique, to note that the drawings in the former appear, to this reviewer, to be more alive and more carefully conceived than in Parson's *Atlas*.

Although there is scant text in the atlas, the page of helpful hints for hysterectomy is a gem, worthy of reading.

The operation illustrated as the Pomeroy procedure is certainly not the one described originally. Crushing of the tube prior to a ligature may well defeat the very purpose of the operation.

So many fatal accidents have been described following the use of air for tubal insufflation that the techniques involving the use of hand bulbs as shown in this atlas must be considered reprehensible.

The above criticisms are minor. This is an excellent work worthy of perusal and a fine addition to the gynecologist's library.

**Atlante di citodiagnostica del carcinoma dell'utero.** By Dr. Enzo Mantella, Clinica Obstetrica e Ginecologica della Univ. di Napoli. 23 pages with 107 illustrations. Naples, 1952, Casa Editrice V. Idelson. 2400 L.

During the past decade, much has been written on the role of cytology in the diagnosis of uterine malignancies. The development of the Papanicolaou smear technique has given a tremendous impetus to the early detection and treatment of these conditions. The significance and role of the vaginal smear are being evaluated in the gynecological clinics throughout the world. This well-illustrated atlas of diagnostic cytology has been published from the material studied at the Obstetrical and Gynecological Clinic of the University of Naples. The volume is a concise but graphic representation of the technique of the vaginal smear and its interpretation. The publication of similar books in all the languages of the world will greatly enhance the position and knowledge of the gynecologist in his struggle against uterine malignancies.

**Operative Gynecology.** By Richard W. Te Linde. Second edition, 856 pages with 409 figures and 7 color plates. Philadelphia, 1953, J. B. Lippincott Company. \$20.00.

The second edition of Te Linde follows the first by some six years and is quite timely, for this valuable volume has been out of print and unobtainable.

The new edition has kept pace with the progress in gynecology over the intervening years. The section on uterine cancer has been greatly expanded. It includes a fair and reasonable presentation of cytological diagnosis. Carcinoma in situ is considered so important that it is presented in an independent section. Here one finds one of the sanest discussions of this controversial field that this reviewer has yet encountered. The photomicrographs in this volume, and particularly those in the section on carcinoma in situ, can only be described as superb. The two sections referred to above occupy but sixty-three pages including references, yet here are simply presented such a mass of concrete facts and data concerning uterine carcinoma as to amply repay the reader for the rather high cost of this volume.

The section on urinary incontinence is quite worthy of note. Almost all of the current operations are well described and their advantages presented. The illustrations here are excellent.

The section on sarcoma of the uterus is ample, but the section on operations to correct uterine deformities and in particular double uterus seems out of proportion to the relative frequency and importance of this condition. The section on anesthesia is quite adequate.

The book is written primarily for men in their graduate years, secondarily for the specialist. It does not particularly concern the medical student, although it makes an excellent reference text for him. There is a particular quality of simplicity in Te Linde's writing which combines the humility of the scholar with the clear exposition of the teacher. Notwithstanding this simplicity, one is well aware of the author's vast clinical background plus the fact that this is a highly personalized work. These characteristics make this text alive and exciting reading. The drawings of James Dedusch and Elinor Bodian are reminiscent of Brödel whose illustrations are well known to all the readers of surgical text for their fine artistry and high degree of anatomic integrity. The work of Brödel's students and followers is immediately recognizable wherever it appears for the very same characteristics. This volume by Te Linde can well take its place alongside the texts of Kelly, Cullen, and Halsted, not only for its excellent text but for the continuing presentation of a school of medical illustration which has yet to be surpassed.

### Miscellaneous

**Morris' Human Anatomy.** Edited by J. Parsons Schaeffer, A.M., M.D., Ph.D., Sr.D., D.Litt. Eleventh edition, 1607 pages with 1200 illustrations. New York, 1953, The Blakiston Company. \$16.00.

The eleventh edition of *Morris' Human Anatomy*, edited by J. Parsons Schaeffer, is a worthy successor to its famous predecessors. First published in 1893 by Sir Henry Morris, a distinguished surgeon and teacher of his day, this text of anatomy spans sixty years and has been maintained as one of the finest anatomy texts published.

The eleventh edition has been extensively revised and rewritten and includes many new illustrations. The format has been largely maintained, however, and the bibliography and index are as extensive and complete as usual.

The section on developmental anatomy should hold particular interest for the obstetrician-gynecologist. It is well done, concise, complete, and readable. There is an extensive section devoted to the development of the female genital tract. The sections on pelvic anatomy are very good and are accompanied by five illustrations.

Dr. Schaeffer is to be congratulated for a fine job of editing and the book is highly recommended as a worth-while addition to every physician's library.

**Sexual Harmony in Marriage.** By Oliver M. Butterfield, Ph.D., with an introduction by Nadina Kavinoky, M.D. 96 pages with 3 illustrations. New York, 1953, Emerson Books, Inc. \$1.50.

This small volume is a concise and clear presentation for the engaged or married couple. In easy language a vocabulary and the essentials of the sexual side of marriage are presented.

A few psychosomatic principles are explored but the major theme is maintained on a practical, down to earth, easy to understand level.

The anatomical charts are simple and readable. These, with the clearly written text, give a clear understanding of the anatomy involved.

This extension of Dr. Butterfield's previous *Marriage and Sexual Harmony* is enthusiastically recommended.

**Adventures in Artificial Respiration.** By Peter V. Karpovich, J.P.E., M.D. 303 pages with 127 illustrations. New York, 1953, Association Press. \$7.50.

This book concerns itself primarily with the history and development of manual types of artificial respiration. The author discusses some 117 methods of artificial respiration and, in addition, has prepared tables for the identification and classification of these methods. The scientific basis for some of the more popular ones is extensively reviewed in an effort to select "the best method."

There are some chapters devoted to the discussion of the anatomy of the lungs, mechanics of respiration, physiology of respiration, etc. These are written so that an intelligent lay person should, more or less, be able to follow and use the material presented as a basis for understanding just what one is attempting to do when performing artificial respiration.

The author emphasizes the need for a knowledge of a number of methods so that one particular method may be selected which best suits the situation at hand.

The book is well written with large easily legible type and is generously illustrated. The various methods of artificial respiration are clearly described. This is excellent source material for all those charged with the responsibility of teaching artificial respiration and should be of interest to those physicians who are particularly concerned with problems of resuscitation.



**Klinische Vorlesungen.** By Dr. Walter Stoeckel. 74 pages. Stuttgart, 1953, Georg Thieme Verlag.

This book is composed of four lectures which embody some of the wisdom of the eminent Professor Stoeckel. The first deals with hemorrhage in late pregnancy, the second with cancer detection, the third with urinary tract infections in pregnancy, and the fourth with conception and sterility.

With respect to placenta previa and abruptio, the ideas expressed closely mirror current practice in this country. There is, however, a greater emphasis on methods of delivery from below than is customary here.

With respect to carcinoma detection, the most salient feature of the presentation is the recommendation of the colposcope as an aid to biopsy. In the opinion of this reviewer this instrument has been so successful in German hands that it is worthy of a trial in some of the larger American clinics.

Urinary infections are said to be transferred by way of the blood stream from the intestine. Their development is furthered by the compression of the ureter in the pelvis during pregnancy and the concomitant change in bladder topography. Treatment is based upon the sulfonamides and also streptomycin in severe cases.

In the section on conception and sterility, the author advises extensive study of the male. He feels that retroflexion of the uterus may frequently prevent conception. Discussion of the cervix, coupled with the Alexander-Adams suspension, is regarded as a worthwhile procedure, although it has long been given up in this country. Iodized oil is advised for hysterosalpingography. The author believes that conception may occur at any time during the ovarian cycle.

**Ansprachen.** By Prof. Dr. Walter Stoeckel. Geheimer Medizinalrat, Berlin. 136 pages. Stuttgart, 1952, Georg Thieme Verlag. DM 7.80.

This pamphlet is a compendium of eleven addresses delivered by Prof. Stoeckel on various ceremonial occasions from 1925 to 1951. Several of the speeches make interesting reading, particularly those dealing with the effect of the war upon German medicine.

**The Breast in Roentgen Diagnosis.** By Raul A. Leborgne, M.D. 194 pages with 307 illustrations. Montevideo, 1953, Impresona Uruguaya, S.A.

Leborgne is to be commended for his lucid portrayal of the role of roentgenology in the diagnosis of breast lesions. The refined techniques of his clinic represent years of study and experience. The roentgenographic findings are well correlated with gross and microscopic pathology in a myriad of conditions. The limitations of this type of examination must not be overlooked. Not only will the physical condition of the breast but also the training and experience of the roentgenologist influence the accuracy of this type of x-ray examination. In the present day when surgery constitutes the major therapeutic approach to breast lesions, few roentgenologists will have the opportunity or need to become expert in the techniques so graphically described in this book.

**The Book of Health.** Edited by R. Clark and Russell Cumley. 769 pages. New York, 1953, Elsevier Press, Inc. \$10.00.

*The Book of Health* is an excellent compilation of general medical information suitable for dissemination to the lay public. The style of presentation is new and progressive. The contributors are eminently qualified.

Briefly, the book is divided into twenty-eight chapters. After introductory chapters describing the beginning of life and the normal development of the infant to adulthood, each major organ system is then described anatomically and physiologically in health and disease. The remaining chapters discuss nutrition, sickness at home, first aid, tropical diseases, sanitation, forensic medicine, the history of medicine, and the relationship between the medical and allied professions.



Treatment of disease is described simply, briefly, and in the broadest general terms with the constant reminder that such treatment is to be administered only under the direct supervision of the physician.

There is much useful information included for the lay person to enable him to understand what constitutes health and what constitutes disease. For example, in the chapter on the breast, the necessity for the early detection of cancer is well stressed and very lucid instructions for self-examination of the breast are clearly outlined both in the text and by photographic illustrations. Again, in the description of the management of diabetes mellitus, useful information by text and illustration is provided concerning the testing by the patient of urine for sugar and acetone, the self-administration of insulin, and the care of the feet in the diabetic.

The book is remarkably well illustrated with explanatory diagrams simplifying the text, along with many very interesting familiar prints depicting the progress of medicine from antiquity to the present. Perhaps the photographic illustrations depicting corneal transplantation, circumcision, and operation for the undescended testicle could well be omitted as being outside the scope of this book.

While this book will be of great value to the patient, it will also serve well as an authoritative source of information for the student of physiology and hygiene and the many auxiliary workers in the medical field.

**Bakteriologische Nährböden.** By Dr. L. Hallmann, Hamburg, Germany. 252 pages with 52 illustrations. Stuttgart, 1953, Georg Thieme Verlag. DM 19.80.

It is the intention of the author to provide a basis for the rational and reliable preparation of the media for bacteriological diagnosis. This purpose he accomplishes very well.

The book is divided into two main parts. The first gives a general bacteriological and chemical background of the principles involved in microbiological diagnosis. The second and preponderant section details, on one hand, the uses of special media such as blood agar and ascitic fluids, and, on the other, the peculiar requirements and idiosyncrasies of bacteriological, mycotic, and protozoan pathogens.

The imaginative use of a thumb-hole index in addition to a good subject index makes this a very handy reference volume. The appeal of this work for the American reader, however, is limited by the fact that several of the raw materials common to a large number of substrates described in the book are peculiar to the German market.

## Books Received

The following books have been received and selected reviews will appear in later issues of the JOURNAL.

TITLE	AUTHOR	PUBLISHER
Childbirth Without Fear	Grantly Dick Read	Harper & Brothers
Die Funktionelle Harninkontinenz der Frau	Hubert Hartl	Ferdinand Enke Verlag
Die Beinegungs-Bestrahlung	F. Wachsman and O. Barth	Georg Thieme Verlag
Die Narbestrahlung	Henri Chaol and Felix Washsmann	Georg Thieme Verlag
Diagnostiek En Therapie Van Het Steriele Huwelik	Detrus C. Kok	H. E. Stenfer Kroese
Endocrinology in Clinical Practice	Gilbert Gorden and H. Lissner	Year Book Publishers, Inc.
Fool's Haven	C. C. Cawley	House of Edinboro
La Sterilita Nel Maschio	Guglielmo Longo	Diffusion Scientifique Internationale
The Practice of Balanced Anesthesia	Sylvan M. Shane	Lowry and Volz
Psychosomatic Approach to Gynecology and Obstetrics	Fritz Wengraf	Charles C Thomas
Diseases of Women	Robert James Crossen	The C. V. Mosby Company
Health Services for the Child	Edward Schlesinger	McGraw-Hill Book Company, Inc.
Human Embryology	Bradley Patten	Blakiston Company
Sexual Behavior in the Human Female	Alfred Kinsey, Wardell Pomeroy, Clyde Martin, and Paul Gebhard	W. B. Saunders Company
Die Kreuzschmerzen der Frau	Heinrich Martius	Georg Thieme Verlag

## Selected Abstracts

EDITED BY GEORGE W. KOSMAK, M.D., NEW YORK, N. Y.

### Cancer, Malignancies

**Blanchard, Oscar:** Cancer of the Cervical Stump, *An. brasil. de ginec.* 17: 353, 1952.

The author reports 7 cases of carcinoma of the cervical stump from a series of 60 cases of cancer of the cervix. He emphasizes the seriousness of the disease because of the lack of early symptoms which would allow an early diagnosis of the incipient growth. Because of this lack of early symptoms, most of these cases report to the doctor too late, and parametrial and glandular involvement is already present. Because of the fact that all these patients were operated upon for benign uterine tumors four months to eleven years before the last admission, the author makes a plea for more radical surgery in cases of benign uterine lesions.

The clinical history of 7 cases is included and it is worthy of note that 4 of the total number of cases were treated by the Brunschwig procedure, cystectomy, cervical amputation, parametrial excision, bilateral gland excision, and ureterosigmoid anastomosis. The remaining 2 patients signed themselves out.

RICARDO L. GORBEA

**Martin, Purvis L., Slate, Thomas A., and Merritt, John W.:** Routine Smears—A Practical Method for Cytodetection of Unsuspected Cervical Cancer, *West. J. Surg.* 61: 102, 1953.

The value of vaginal-cervical smears in the detection of early cervical carcinoma is now generally accepted. Every doctor's office should be a cancer detection center. From a large private practice there is reported the authors' experience with 3,070 routine smears from 2,840 private patients over a two and one-half year period. The plan for carrying on such a study in private practice is described. Each examining table is equipped with ordinary tongue blades, frosted slides, pencil, and a bottle of ether-alcohol mixture. Without special preparation, a speculum is inserted into the vagina and the region about the external os wiped several times with the tip of the tongue blades. The collected material is spread thinly over a slide and placed immediately into the 50 per cent ether-alcohol mixture. The smears are sent to a clinical laboratory for staining and study.

Of the 3,070 routine smears 44 were reported as positive for cancer cells. Cancer was confirmed by biopsy or curettage in 37, leaving 7 unconfirmed false positives for further follow-up. Over a period of five years the procedure discovered 43 clinically unsuspected early cancers that otherwise would have been completely missed. Noninvasive cancer is thought to be much more common among women in their thirties than is generally believed. Indeed the incidence of noninvasive cancer in younger women is greater than the incidence of invasive cancer in older women. This means that certain early cancers are reversible either spontaneously or through the ordinary office procedures such as electrocoagulation of the cervix. Time only will tell how many early noninvasive cancers of the cervix are cured by the simple office routines.

WILLIAM BICKERS

**Senra, A.:** Primary Cancer of the Fallopian Tube, *An. brasil. de ginec.* 34: 211, 1952.

The author reports a case of primary carcinoma of the Fallopian tube diagnosed on the excised specimen after histopathologic examination. The author reviewed the litera-

ture since 1851 when the first case of primary carcinoma of the Fallopian tube was reported and found approximately 500 registered cases since then. In the Brazilian literature only 2 cases, including the present one, are registered. The writer reports on the incidence, clinical diagnosis, etiology, pathology, treatment, and prognosis of one of the most rare and hardest to diagnose of all cancers of the female genital tract. The only way a diagnosis can be made is for the gynecologist to have in mind the possible existence of the disease. Hysterosalpingography and culdoscopy are procedures which will aid in the diagnosis of this condition preoperatively and in time for a more definitive cure.

This case was registered as a primary adenocarcinoma of the salpinx.

RICARDO L. GORBEA

### Gynecological Operations

**Monte De Oca, C. J.: Hysterosalpingography and Its Relation to Diagnosis of Pelvic Tumors of Genital Origin, Rev. mex. de cir., ginec. y cancer 20: 254, 1952.**

The clinical and topographic diagnosis of pelvic tumors of genital origin is not an easy matter; the data obtained through bimanual palpation are sometimes not conclusive enough to determine whether the tumor is uterine or parauterine in origin. It should be apparent, then, how important a method of exploration like hysterosalpingography is in establishing a definite diagnosis. The value of this method depends on the ability of extrinsic and intrinsic tumors to modify the image of the uterine and tubal cavities. The author in describing the procedure makes it evident that it is a simple and harmless one, and wonders why it is not used more frequently.

RICARDO L. GORBEA

**Knaus, Hermann: Observations and Results After 600 Radical Wertheim and Shauta operations, Wien. klin. Wchnschr. 64: 870, 1952.**

The author reports 600 operations performed from 1927 to 1952, with a primary fatality of 1.6 per cent. At the beginning he preferred the Schauta operation, later the Wertheim. At present he uses the vaginal approach only in patients with thick abdominal wall, wide vagina, small tumor, small movable uterus, and in elderly individuals. The right choice of the appropriate method lowers remarkably the primary fatality rate. The appreciation of operability is of importance as well. Caution is recommended. Knaus operated in only 26 per cent of all cases and treated 74 per cent by x-rays. As the radical operation requires a highly developed technique the example set in Sweden seems desirable in that surgical centers are staffed with first-rate surgeons who alone are to be authorized to operate on carcinoma of the cervix.

C. J. EHRENBERG

**Vaz, O.: Urogenital Fistulas in the Female, Rev. brasil. de cir. 24: 368, 1952.**

The author in an extensive and meticulously written article reviews the whole subject of genitourinary fistulas in women, stating that 90 per cent of these are of obstetrical origin. A decrease of this complication will follow when better obstetrical care is given, especially in the rural areas. Ureteral fistulas following radical surgery for cancer of the cervix are second in frequency. This rate will also diminish when better training in this type of surgery is available. The greater use of the total hysterectomy instead of the subtotal procedure is also one of the main reasons for a greater number of fistulas following surgery.

In the therapeutic approach to a urinary fistula, a complete endoscopic study of the urinary tract should be routine before any surgical procedure is selected. At least 90 per cent of the fistulas occurring in women should be approached through the vagina. Good exposure with wide dissection of the fistulous tract as well as use of absorbable sutures followed by continuous drainage of the bladder after operation is the best technique to follow.



The author summarizes his indications for the transabdominal approach of these fistulas as follows:

A. Intraperitoneally and extravesically, in highly located fistulas following total hysterectomy in the virgin and when the fistula is vesicocervical.

B. Extraperitoneally and intravesically, when there is vaginal narrowing and the bladder is attached to the pubis, and when the vaginal approach has been tried unsuccessfully in previous attempts.

C. Intraperitoneally and intravesically, when there are both ureteral and vesical fistulas at the same time.

D. Extraperitoneally and extravesically in the vesicoabdominal fistulas.

The author is of the opinion that the ureterocystoneostomy is the ideal procedure for treating uncomplicated ureteral fistulas. He believes that the ureterosigmoidostomy is a procedure that should be used only when there are definite and very precise indications for it. In spite of antibiotics this latter procedure is not considered a reliable one to use.

RICARDO L. GORBEA

### Gynecology

McKay, Donald G., Hertig, Arthur T., and Hickey, William F.: *The Histogenesis of Granulosa and Theca Cell Tumors of the Human Ovary*, *Obst. & Gynec.* 1: 125, 1953.

The various theories concerning the origin of granulosa-cell tumors are briefly discussed.

From experimental work in mice and observations in the human being the authors postulate that granulosa-cell tumors have their origin in atretic follicles which contain persistent granulosa cells. The evidence in support of this postulate is that the biologic background of residual granulosa cells in atretic follicles in human ovaries is similar to that of the tissue which in experimental animals eventuates in granulosa-cell tumors. The sequence of events appears to be disintegration of the ovum, luteinization of the stromal or thecal cells, and persistence of granulosa cells. A microscopic granulosa-cell tumor arising in an atretic follicle has been described. Furthermore, granulosa-cell tumors may produce structures resembling atretic follicles indicating that the tissue of origin may be reproduced by some of these tumors.

On the other hand it is felt that theca-cell tumors have their origin in cortical stromal hyperplasia. The evidence in support of this is that the histologic pattern of both tissues is identical and that transition stages between cortical stromal hyperplasia and thecomas are seen. Patients with theca-cell tumors of one ovary almost invariably have cortical stromal hyperplasia of the opposite uninvolved ovary and both conditions occur primarily in the postmenopausal age group.

ELMER E. KRAMER

Begg, R. Campbell: *There Are No Urethral Caruncles*, *Lancet* 1: 824, 1951.

After years of looking without success for a "caruncle" which was not a urethral prolapse or inflammatory process, the author concludes that the term caruncle should be abolished. The word caruncle meaning "a little bit of flesh" has no pathologic significance. In the rare cases where it does not denote a partial or complete prolapse of the urethra, it refers mistakenly to an undiagnosed carcinoma.

The chief cause of urethral prolapse is infection present or past, and this is the most important point to remember in treatment. Only on few indications is fulguration or excision necessary, and it should then be planned with full consciousness that one is dealing with a prolapse. Biopsy might be necessary, but it is never necessary to excise the typical eversion of the mucosa.

IRVING L. FRANK

### Pregnancy, Physiology

**Hughesdon, P. E.: The Fibromuscular Structure of the Cervix and Its Changes During Pregnancy and Labour, J. Obst. & Gynaec. Brit. Emp. 59: 763, 1952.**

Hughesdon of the University College Hospital Medical School, London, studied the structure of the cervix and its changes during pregnancy and labor. He stained longitudinal sections from 31 pregnant and 55 nonpregnant cervixes to demonstrate collagen and muscle. He found that the cervix was composed of an outer fourth and an inner three-fourths. The outer fourth was composed of strong, mature, functioning muscle fibers which are continuous with the muscle of the corpus above and with those of the vagina below. The inner three-fourths of the cervix consists chiefly of collagen and scattered, weak, immature, probably nonfunctioning muscle fibers.

During pregnancy the collagen fibers are separated by fluid and some are even re-absorbed, thus causing softening of the cervix. The immature muscles of the inner part hypertrophy during early pregnancy and then remain stationary. The changing relationships of the inner mass of noncontractile tissue composed of collagen, immature muscle, and fluid, and the outer mass, composed of the mature muscle layer, result in the effacement and dilatation of the cervix as term approaches. There are 22 excellent photomicrographs which illustrate the above claims.

WILLIAM F. FINN

**Rodrigues Lima, O., and Benning, Kamnitzer M.: Colpocytology in Obstetrics, Rev. port. obst. ginec. e cir. 5: 289, 1952.**

The authors in this article describe the cytological vaginal smear pattern in pregnancy, labor, and the puerperium. During the first trimester of pregnancy cyclical changes were observed characterized by periodic elevations of the pyknotic and eosinophilic indices. From the fourth month of pregnancy until labor the cytological pattern was observed to remain constant. At the onset of labor a radical modification was noted by a sudden increase of the pyknotic and eosinophilic index, the appearance of mucus and cells from the different layers of the cervix. During the puerperium, as long as the lochia subsists, the vaginal smear was represented almost exclusively by basal cells and cells from the uterine cavity. The authors report typical changes in the cytological pattern in cases of threatened abortion and miscarriages and also death of the ovum. The semi-logical value of these changes are emphasized. These changes were classified in five groups: (a) normal gestational smear, (b) threatened abortion, (c) inevitable abortion, (d) probable death of ovum, (e) definite death of ovum. These changes were checked in clinical cases reported, including one case of molar pregnancy with subsequent abortion. The authors consider the vaginal smear as an excellent method by which to determine diagnosis and prognosis in cases of threatened abortion and ovular death. The article is illustrated with five drawings depicting the five main classical patterns.

RICARDO L. GORBEA

**Bruns, Paul D., Snow, Robert H., and Droese, Vera E.: Effect of Dihydroergotamine on Human Uterine Contractility, Obst. & Gynec. 1: 188, 1953.**

Discussed are the results of varying concentrations of dihydroergotamine (DHE-45) upon uterine contractility in 40 parturient patients. The tokodynamometer with three externally placed strain gauges was used to record uterine changes. Twenty-five normal patients in early labor received DHE-45 by the intravenous method. In low concentrations (0.002 mg. per kilogram of body weight) an initial transitory decrease in work output occurred, followed by a steady increase. In higher concentrations (0.02 mg. per kilogram of body weight) uterine contractility was invariably and markedly increased. The remaining 15 patients received DHE-45 in a single dose (0.25 to 1.0 mg.) intravenously to

study its effect upon uterine inertia and the induction of labor. However, the method was soon abandoned because of the alarming increase in the rate of contractions and the occasional occurrence of fetal distress. No clinical evidence was found to substantiate or disprove the theory that DHE-45 relaxes the cervix.

ELMER E. KRAMER

### Radiation

**Marsalek, J.: X-ray Picture of Uterine and Tubal Tuberculosis, Gynaecologia 135: 37, 1953.**

Among all the organs of the female genital tract, the tubes are most often attacked by tuberculosis. In half of these cases, the infection spreads to the uterus. Diagnosis of this disorder is sometimes difficult. Amenorrhea and primary sterility were the commonest causes for seeking professional advice. Although hysterosalpingography has been known for almost 40 years, the use of this procedure has not been readily adapted for diagnosis of tuberculosis until quite recently. The author believes that an oily contrast medium is the best for outlining either destructive or productive tubercular changes. He states that the technique of the test must be fixed and definite. The procedure which was followed included: (1) The uterus was filled under fluoroscopic control. (2) A pre-test picture must be taken to eliminate or confirm extragenital calcified areas such as lymph nodes. (3) A "relief" picture, after the uterus is emptied, must be taken to be able to recognize endometrial changes. (4) The contrast medium must not contain bubbles which on the relief picture might be taken for tubercles. (5) The pressure under which the contrast medium is injected into the uterus must be low so as not to disturb adhesions in the tubal ampulla and thus bring about dissemination of the infection over the peritoneum.

Diagnosis by hysterosalpingogram must be confirmed by other procedures. This can be done by either curettage or surgery, removing such portions as is deemed advisable for histologic examination for tubercles or for culture of pus or other material for Koch's bacillus.

Findings on x-ray are as follows: Diagnosis of tuberculosis of the cervix by feathered shadows is not correct. These featherings are due to dilated, infected cervical glands and not to tubercular changes. Tuberculous changes of the cervix, like changes of the endometrium, are best found on the relief picture, and appear as sharp round or ovoid defects. Apart from this, tuberculosis of the endometrium is evidenced by an uneven fundal shadow, together with thornlike indentations. Tuberculosis of the tubes usually occurs in 3 characteristic pictures: (1) destructive changes in the muscularis and mucosa causing lack of homogeneity and fistulous tracts, with outlines of the tubal lumen being irregular and serrated and the ampulla closed and dilated; (2) productive changes which are visualized as a straight tube, somewhat resembling a baton; or (3) an intermediary type, which demonstrates interrupted filling resembling a rosary. In this type the ampulla is closed and after 24 hours is nonhomogeneous and has veiled or serrated edges.

L. B. WINKELSTEIN

### Sterility, Fertility, Contraceptives

**Pous Puigmacia, L.: Functional Obstructions of the Tubes as a Cause of Sterility, Bol. Soc. de obst. y ginec. de Buenos Aires 31: 366, 1952.**

The author in this paper elaborates on the incidence and occurrence of spastic phenomena of the tubes in selected cases and brings out facts and pertinent knowledge that should be at the command of the gynecologist to overcome this condition as a factor in sterility. He has determined that functional spasm occurs during or shortly following ovulation by doing carbon dioxide insufflation at this time and also during the proliferative

stage of the cycle. In the proliferative phase there is complete passage of the gas, while in the secretory phase there is complete occlusion of the tubes. He also found that during this phenomenon the gas is expelled forcefully through the cervix when the pressure reaches 100 to 150 mg. of mercury regardless of how snugly the cannula is affixed against the cervix. At this time the patient experiences pain at the central portion of the lower abdomen rather than laterally. The author feels that this spastic condition is brought about by two factors, one the anatomic factor and the other the constitutional hormonal factor. The treatment suggested is as follows: Use of antispasmodics such as papaverine, Luminal and tetraethyl ammonium iodide. The basic treatment used to overcome the hormonal factor consists of injections of 25 mg. of testosterone with 10 mg. of progesterone upon the twelfth, nineteenth, and twenty-third days of the menstrual cycle. These days are picked so that physiologically the pituitary action is decreased, the action of folliculin neutralized, and the progesterone action is reinforced. The article is illustrated with four charts.

RICARDO L. GORBEA

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## Item

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### American Board of Obstetrics and Gynecology

The American Board of Obstetrics and Gynecology will hold the next scheduled examinations (Part II), oral and pathological, for all candidates at the Edgewater Beach Hotel, Chicago, Ill., May 10 through May 17, 1954. Formal notice of the exact time of each candidate's examination will be sent him several weeks in advance of the examination dates.

It is called to the attention of all candidates for re-examination in Part II that they must make written application to the Secretary's office not later than April 1, 1954.

Application forms for Appraisal of Incomplete Training, for Certification, and requests for current Bulletins should be made to:

ROBERT L. FAULKNER, M.D., Secretary  
American Board of Obstetrics and Gynecology  
2105 Adelbert Road, Cleveland 6, Ohio

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## Erratum

In the article, "The Incidence and Anatomical Distribution of Basal-Cell Hyperactivity and Its Relationship to Carcinoma of the Cervix Uteri," by Grace H. Guin, M.D., in the JOURNAL for May, 1953, page 1081, a footnote was omitted which stated that Dr. Guin was a Postdoctorate Fellow of the National Cancer Institute.